THE CORPORATION OF THE
TOWN OF BLIND RIVER

TENDER FOR NEW BLIND RIVER WATER TREATMENT PLANT INTAKE AND LOW LIFT PUMPING STATION

CONTRACT NO. PS-2026-01

Consultants

Tender Close: Friday, March 6th, 2026 - 3:00 pm

TENDERING CHECKLIST

The following checklist has been included to ensure that all of the Town's requirements are met:

1. Each Bidder shall submit with their tender a certified cheque or bid bond in the amount of 10% of the contract price. ☐

2. The Bidder must provide an Agreement to provide Performance Security. ☐

3. Return the Form of Tender properly completed and signed where indicated. ☐

4. Ensure the Addendums Received Section of the Form of Tender has been completed if any addendums have been issued. Failure to complete this section when addendums have been issued may render your Tender as non-compliant. ☐

5. The Tendering Information, Construction Specifications and Special Provisions Sections have been carefully reviewed and all requirements have been submitted with your Tender. ☐

6. The Bidder has attached a proposed schedule for the works, showing compliance with the start and final completion dates. ☐

The Corporation is not bound to accept the lowest or any tender and reserves the right to reject all tenders. The Corporation also reserves the right to evaluate the tenders in any manner it deems fit.

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TI.01 GENERAL

Please read this section carefully.
These general conditions, instructions to Tenderers, and specifications forming a part of this tender, shall constitute a valid and binding contract between the successful Tenderer and The Corporation of the Town of Blind River and it shall ensure to the benefit of, and be binding upon both their successors, executors, administrators and assigns.

TI.02 DEFINITIONS

The words “Corporation” and “Owner” mean The Corporation of the Town of Blind River.

The Words “Director of Public Services” shall be understood as referring to that of the Town of Blind River.

The word “Engineer” shall be understood as referring to TULLOCH Engineering Inc.

The word “Contract” means the agreement to do the work entered into with the Corporation, the general conditions, the specifications, the drawings, and other documents referred to or connected with the said contract.

The words “Contractor” or “Tenderer” means the person or persons who have undertaken to carry out this contract.

The words “Town” and “Corporation” may be used interchangeably with the same intent and meaning for the purpose of the contract.

The word “Work” shall mean the execution of the whole work, and things required to be done, mentioned, or referred to, in the contract documents and including all extra or additional work that may be ordered by the Engineer.

The words “Working Day” mean any weekday,

A. except Saturdays, Sundays, and statutory holidays;

B. except a Day as determined by the Contract Administrator, on which the Contractor is prevented by inclement weather or conditions resulting immediately there from, from proceeding with a Controlling Operation. For the purpose of this definition, this will be a Day during which the Contractor cannot proceed with at least 60% of the normal labour and equipment force effectively engaged on the Controlling Operation for a least 5 hours;

C. except a Day on which the Contractor is prevented from proceeding with a Controlling Operation, as determined by the Contract Administrator by reason of,
   i. any breach of the Contract by the Owner or if such prevention is due to the Owner, another contractor hired by the Owner, or an employee of any one of them, or by anyone else acting on behalf of the Owner.
   ii. on-delivery of Owner supplied materials,
   iii. any cause beyond the reasonable control of the Contractor, which can be substantiated by the Contractor to the satisfaction of the Contract Administrator.

An exception will not be made to the Contractor for the Contractor's inability to provide the normal labour and equipment force for at least 8 hours per day, 5 days per week, Monday through Friday on a Controlling Operation, as a result of other contracts, projects or activities the Contractor may be completing.

The words "Controlling Operation" mean any component of the Work, which, if delayed, will delay the completion of the work.

TI.03 TENDER DOCUMENTS

D. All tenders must be completed on the printed forms supplied for that purpose. No others will be considered. Each tender shall be in accordance with the Contract Documents and shall include a completed Form of Tender, Tender Deposit, Security Agreement, List of Tenderer's Senior Staff, List of Subcontractors and Proposed Schedule.

TI.04 DELIVERY AND OPENING OF TENDERS

E. SEALED TENDERS, enclosed in an envelope clearly identified as **"**Tender for PS-2026-01 – New Blind River Water Treatment Plant Intake and Low Lift Pumping Station**"** and addressed to the **CAO/Clerk** will be received at The Corporation of the Town of Blind River, 11 Hudson Street, Blind River, ON P0R 1B0, up to **3:00 p.m., local time, on Friday, March 6th, 2026.**

F. Alternatively, digital submissions will be accepted at info@blindriver.ca prior to the above-mentioned closing date and time, addressed to the CAO/Clerk, referencing "Tender for PS-2025-02 – New Blind River Water Treatment Plant Intake and Low Lift Pumping Station" as the subject line.

G. The tenders will be opened on **Friday, March 6th, 2026,** at **3:15pm local time** at the Municipal Office. Bidders can attend the tender opening. Only the Total Tender Price will be announced at the opening.

H. The Corporation reserves the right to reject any or all bids and the lowest tender will not necessarily be accepted.

I. Tenders shall be completed on the Form of Tender included with the Contract Documents.

TI.05 DEADLINE FOR QUESTIONS & RESPONSES

J. All questions during the tendering period must be submitted to the Engineer in writing via email, prior to 5:00pm on March 20th, 2026. No such communications are to be directed to anyone other than the Engineer as follows.

Chris Kirby, P.Eng, Project Manager
TULLOCH Engineering Inc.
Email chris.kirby@tulloch.ca

K. The Engineer will issue all responses as soon as possible after receipt, however no later than 5:00pm on March 25th, 2026. Responses will be via addendum posted on the Town of Blind River website. No oral interpretation will be effective to modify any provision of the Contract Documents.

TI.06 DISCREPANCIES

L. Should a Tenderer find discrepancies in or omissions from the Contract Documents, or be in doubt as to any meaning, the Tenderer shall notify the Engineer, who may issue a written addendum. Neither the Owner nor the Engineer will make oral interpretations of the meaning of the Contract Documents.

M. Should the Tenderer not agree that the materials and methods specified, or designed on the Drawings, will provide an installation to meet the requirements of the project, the Tenderer shall notify the Engineer in writing, stating the reason for the objection and may submit a suggested alternative. In such an event, the Engineer may choose to issue an addendum.

TI.07 ADDENDA

N. Addenda issued during the tendering period shall be allowed for by the Tenderer. Addenda shall be posted on the Town of Blind River website https://www.blindriver.ca/town-hall/bids-and-tenders/ It is the responsibility of all prospective Tenderers to monitor the website and ensure that any change to the tender document in the form of an addendum is responded to appropriately. Addenda will be issued under the following circumstances:
   a. Interpretation of Tender documents as a result of queries from prospective Tenderers;
   b. Revision, deletions, additions or substitutions of any portion of Tender documents.

O. All such changes as addressed in the addenda shall become an integral part of the Tender documents and shall be allowed for in arriving at the Tender price. Addendums, which have financial implication and have not been acknowledged on the Form of Tender, may be automatically rejected. Oral instructions shall not be considered valid unless confirmed in writing through the Engineer.

TI.08 EXAMINATION OF SITE

A. The Tenderers shall visit the site of the Work before submitting their tender and shall by personal examination satisfy themselves as to the local conditions that may be encountered during construction of the Work. They shall make their own estimate of the facilities and difficulties that may be encountered and the nature of the subsurface materials and conditions. Access to the site is unrestricted, however the Tenderer shall notify Kathryn Scott, CAO/Clerk, at 705-356-2251 ext. 213 of their intended day and time attending site.

B. The Tenderer shall not claim at any time after submission of their tender that there was any misunderstanding of the terms and conditions of the Contract relating to site conditions.

TI.09 HARMONIZED SALES TAX

P. This project is taxable under the Harmonized Sales Tax (HST).

Q. In calculating unit prices, **DO NOT** include HST payable by the Contractor.

R. The HST payable by the Owner is shown as a separate line in the Schedule of Itemized Prices, and is not to be included in the unit prices. It will be added to the net amount of each progress payment and will be paid to the Contractor.

TI.10 INFORMAL OR UNBALANCED TENDERS

S. All entries in the Form of Tender shall be made in ink or by typewriter. Entries or changes made in pencil shall, unless otherwise decided by the Owner, be invalid or informal. Tenders which are incomplete, conditional, illegible or obscure, or that contain additions not called for, reservations, alterations (unless properly and clearly made and initialed by the tenderer's signing officer) or irregularities of any kind, may be rejected as informal. Tenders that contain prices which appear to be so unbalanced as likely to affect adversely the interests of the Owner may be rejected.

Whenever in a tender the amount tendered for an item does not agree with the extension of the estimated quantity and the tendered unit price, the unit price shall govern and the amount and the Total Tender Price shall be corrected accordingly, unless otherwise decided by the Owner.

A discrepancy in addition or subtraction in a tender shall be corrected by the Owner by adding or subtracting the items correctly and correcting the Total Tender Price accordingly, unless otherwise decided by the Owner. Where an error has been made in transferring the amount from one part of the Form of Tender to another, the amount shown before transfer shall, subject to any correction as provided for above, be taken to be correct and the amount shown after transfer and the Total Tender Price shall be corrected accordingly.

If a tenderer has omitted to enter a price for an item of work set out in the Form of Tender, they shall, unless they have specifically stated otherwise in their tender, be deemed to have allowed elsewhere in the Form of Tender for the cost of carrying out the said work and, unless otherwise agreed to by the Owner, no increase shall be made in the Total Tender Price on account of such omission.

The Owner reserves the right to waive formalities at their discretion.

TI.11 PROOF OF ABILITY

T. The Tenderer shall be competent and capable of performing the various items of Work.

U. The Tenderer shall complete the following statement sheets, which shall form a part of the Contract Documents:

1. Tenderer's Experience on Similar Projects with a list of specific examples completed within the last 5 years.

2. Subcontractors to be employed in the project and the value for the subtrades listed.

3. Tenderer's Senior Staff to be employed, including designating an on-site superintendent of the project. The Site Superintendent can be changed only on the approval of the Engineer.

4. Tenderer's Equipment to be used.

V. The Tenderer may be required to furnish additional statements covering other matters, including financial resources.

TI.12 CHARACTER OF OPERATORS AND ATTENDANTS EMPLOYED

W. The Contractor shall employ only orderly, competent and skillful individuals to do the work and whenever the Director of Public Services shall inform in writing that anyone carrying out the work is, in the opinion Director of Public Services, incompetent, unfaithful or disorderly, such an individual shall be discharged from the work and shall not again be employed on the work without the consent, in writing, of the Director of Public Services.

TI.13 RECORD AND REPUTATION

X. Without limiting or restricting any other right or privilege of the Town and regardless of whether or not a Tender or Proposal or Proponent/Tenderer otherwise satisfies the requirements of a Tender or RFP, the Town may reject summarily any Proposal or Tender from any person where:

1. In the opinion of the Council of the Town of Blind River or the Director of Public Services, the commercial relationship between the Town and the Tenderer/Proponent has been impaired by the prior and/or current act(s) or omissions(s) of such Tenderer/Proponent including but not limited to:
   i. litigation with Town of Blind River;
   ii. the failure of the Proponent/Tenderer to pay, in full, all outstanding payments (and where applicable, interests and costs) owing to the Town by such Proponent/Tenderer, after the Town has made demand for payment of same;
   iii. the refusal to follow reasonable directions of the Town or to cure a default under any contract with the Town as and when required by the Town or the Town's Representatives;
   iv. the Proponent/Tenderer refusing to enter into a contract with the Town after the Proponent or Tenderers tender or proposal, bid or quote has been accepted by the Town;
   v. the Tenderer/Proponent refusing to perform or to complete performance of a contract with the Town, at any time, after the Proponent has been awarded the contract by the Town;
   vi. acts(s) or omission(s) resulting in a claim by the Town under a bid bond, a performance bond, a warranty bond or any other security required to be submitted by the Proponent on a RFP or a Tender; within the five (5) year period immediately preceding the date on which the RFP/Tender is awarded;

2. In the opinion of the Council of the Town of Blind River or the Director of Public Services, there are reasonable grounds to believe that it would not be in the best interests of the Town to enter into a contract with the Proponent/Tenderer, including (without limiting

the generality of the foregoing);

i. The conviction of that person or any person with whom that person is not at arm's length within the meaning of the Income Tax Act (Canada) of an offence under any taxation statute in Canada;

ii. The conviction or finding of liability of that person under the Criminal Code or other legislation or law, whether in Canada or elsewhere and whether of a civil, quasi-criminal or criminal nature, of moral turpitude including but not limited to fraud, theft, extortion, threatening, influence peddling and fraudulent misrepresentation.

iii. The conviction or finding liability of that person under the Environmental Protection Act, or corresponding legislation of any other province or any member of the European Union or the United States of America, where the circumstances of that conviction evidence a gross disregard of the part of that person for the environmental well-being of the communities in which it carries on business;

iv. the conviction or finding of liability of that person relating to product liability or occupational health or safety, whether of Canada or elsewhere, where the circumstances of that conviction evidence a gross disregard on the part of that person for the health and safety of its workers or customers;

v. The conviction or finding of liability of that person under the Securities Act or the corresponding legislation of any other province or any member of the European Union or the United States of America or any state thereof.

TI.14 TENDER DEPOSIT

Y. The tender shall be accompanied by a tender deposit in the form of a Certified Cheque or Bid Bond payable to the Owner in the amount of 10% of the contract price. For digital submissions, any bonds submitted must be provided in a verifiable digital format or e-bond.

The Tenderers shall keep their tenders open for acceptance for 90 days after the closing date or until a contract is awarded with the successful Tenderer whichever comes first. Withdrawal during this period will result in forfeiture or enforcement of the tender deposit.

Upon being notified that the tender has been accepted, the Contractor shall execute copies of the Agreement, supply bonds and insurance documents as specified, and start Work as specified.

Failure to execute the copies of the Agreement, or to supply bonds and insurance documents, within one week of the date of acceptance of the tender, will automatically mean the forfeiture or enforcement of the tender deposit.

Tender deposits of all Tenderers, except the lowest and second lowest Tenderers, will be returned within fifteen (15) working days after the date of tender closing.

Tender deposits of the two low Tenderers will be retained until a tender has been accepted and the contract properly executed.

TI.15 AGREEMENT TO PROVIDE PERFORMANCE SECURITY

Z. Every tender shall be accompanied by either an "Agreement to Bond" completed by a surety

company lawfully doing business in the Province of Ontario for a Labour and Material Payment Bond for 50% of the Total Tender Price and a Performance Bond for 100% of the Total Tender Price.

AA. Such bonds shall be approved by and acceptable to the Owner and must be furnished when the contract is signed by the Contractor. For digital submissions, submissions must be provided in a verifiable digital format or e-bond.

TI.16 CONFLICT OF INTEREST

BB. All firms are required to disclose to the Town any potential Conflict of Interest, may it be pecuniary or otherwise. If a conflict of interest does exist with the potential successful Tenderer, the Town may, at its discretion, refrain from awarding the project to the Tenderer.

CC. The Tenderer covenants that it presently has no interests and it shall not acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance of its service hereunder. The Tenderer further covenants that in the performance of this contract no person having such known interest shall be employed.

TI.17 INDEMNIFICATION

DD. The successful Tenderer shall indemnify and hold harmless the Town of Blind River, its officers, council members, partners, agents and employees from and against all actions, claims, demands, losses, costs, damages, suits or proceedings whatsoever which may be brought against or made upon the Town of Blind River and against all loss, liability, judgements, claims, suits, demands or expenses which the Town of Blind River may sustain, suffer or be put to resulting from or arising out of the successful Tenderer's failure to exercise reasonable care, skill or diligence or omissions in the performance or rendering of any work or service required hereunder to be performed or rendered by the successful Tenderer, its agent, officials and employees.

TI.18 ACCEPTANCE OF TERMS

EE. Each Tenderer, by submitting a Tender, represents that the Tenderer has read, understands and accepts the terms and conditions of this tender in full.

TI.19 ACCEPTANCE OF TENDERS

FF. The Owner is not bound to accept the lowest or any tender and reserves the right to reject any or all tenders and to waive formalities as the interests of the Owner may require without stating reasons therefore.

GG. The Owner also reserves the right to evaluate the tenders in any manner it deems fit.

HH. If the total tender price exceeds available funding the Owner will negotiate with the low Tenderer to adjust tender quantities. In the event that these negotiations are not successful the Owner will

negotiate with the next lowest Tenderer as necessary.

II. The Owner shall not be responsible for any liabilities, costs, expenses, loss or damage incurred, sustained or suffered by any Tenderer before or after, or by reason of, the acceptance or the non-acceptance by the Owner of any tender, or by reason of any delay in the acceptance of a tender. Tenders are subject to a formal contract being prepared and executed.

TI.20 WITHDRAWAL PROCEDURES

JJ. A Tenderer may request that his or her submitted tender be withdrawn, up until the closing time for a particular contract. Withdrawals can only be made in person and the Tenderer wishing to withdraw from a particular tender must attend the Town Office and execute an appropriate withdrawal form, signed by a principal of the Tenderer, or provide a letter from the Tenderer, signed by a principal, withdrawing the Tender.

KK. The withdrawal of a tender does not disqualify a Tenderer from submitting another Tender for the same contract provided that all of the tender procedures are observed and the new tender is received prior to the terminal time for closure. However, unless withdrawal procedures have been followed, more than one tender from the same Tenderer will result in the disqualification of the Tenderer.

LL. The Tender Deposit shall be forfeited to the Town when a Tenderer attempts to withdraw his or her Tender after Tenders have been opened, in addition to any consequence or legal penalty that may apply.

TI.21 RESULTS

MM. The name of all Tenderers and their total bid price shall be deemed public information following the tender opening; however, unit prices will not be disclosed where tenders were requested as a total contract price.

TI.22 EQUIVALENTS

NN. When an article is specified by its trade or other name (whether such name is followed by the phrase 'or equivalent' or not), the Tenderer shall base their tender price on the supply of the named article and no other.

The Tenderer may submit with their tender suggested equivalents to those articles specified by trade or other names. Such submissions shall show the name of the article specified, the name and description of the suggested equivalent, and the total revision to the tender price that would result if the equivalent were accepted.

TI.23 HOLDBACKS

OO. The project is subject to the Construction Act. A **statutory holdback of 10% (ten percent)** will be held back from each progress payment. Release of the 10% statutory holdback will be in accordance with provincial statues and Section GC 8.02.04 of the General Conditions.

PP. To cover rectification costs during the warranty period, the Owner will retain a **guarantee period holdback of 3% (three percent)** of the value of Work done, such amount being held back in each progress certificate. Holdbacks held to cover rectification costs will be retained for a period of twelve months after the date of Completion.

TI.24 WARRANTY PERIOD

QQ. The Contractor shall guarantee that the material and work shall for a period of twelve (12) months from the acceptance date remain in such condition as will meet the Engineer's approval, and that he/she will make good in a permanent manner, satisfactory to the Engineer, any imperfections due to materials or workmanship used in the construction and any damage caused by such imperfections. The decision of the Engineer shall be final as to the nature and cause of such imperfections and the necessity for remedying them.

Should the Contractor fail to comply with the directions of the Engineer, the Engineer may, after giving the Contractor forty-eight (48) hours written notice, perform the necessary work, and the cost may be deducted, or collected by the owner as provided in the contract.

RR. Notwithstanding the provision of the subsection (a) of this clause, the Engineer may, in cases of danger or public safety, make such immediate arrangements for repair as he/she sees fit, and the Engineer will inform the Contractor of such action. The cost of such emergency work shall be borne by the Contractor.

SS. If the Engineer notifies the Contractor, in writing, of imperfections prior to the termination of the warranty period, the Contractor shall make good the imperfections as required in subsection (a) above, notwithstanding that such work of making good may commence after or extend beyond the end of the warranty period.

TT. The contractor shall pay for all additional contract administration, inspection, and material testing costs incurred by the Owner resulting from warranty repair works. Such payments shall be deducted from the warranty holdback amount prior to its release.

TI.25 ROAD CLOSURES

A. The Contractor must comply with the requirements of the Town of Blind River in regards to Traffic Flow on Municipal Streets.

B. Temporary, short term full road closures between intersecting roads may be permitted for the construction of the works, provided notification to affected residents and alternate access is provided. Pedestrian access must be maintained at all times. The road must be reopened to thru traffic each night.

C. The Contractor shall prepare a Traffic Plan for review by the Engineer and Town of Blind River in advance of construction. The Contractor shall be responsible for all traffic control measures required to support the proposed closures, including lane reconfigurations.

D. In areas of closures, resident and business access must always be accommodated with the

affected parties and approved by the Engineer prior to undertaking.

E. The Contractor shall be responsible for all notification and detour signage, as well as notifications to all services, including but not limited to emergency services, refuse & recycling collection and Canada Post.

TI.26 UTILITIES

F. The Contractor shall arrange for buried locates of all utilities prior to commencing construction.

G. The Contractor shall protect all buried and aerial utility lines during construction.

H. On direction of the Utility, the Contractor will be required to have the Utility provide support to utility poles or lines during excavation operations adjacent to the poles.

I. The Contractor shall be responsible for any third-party observations as may be required by the utility company.

J. The Contractor shall complete all work near the Enbridge Gas Line in accordance with Enbridge requirements, including, but not limited to monitoring, blasting plans and leak testing.

TI.27 LABOUR & MATERIALS

K. The contractor shall provide and furnish all manner of labour, materials, apparatus, utensils, and cartage of every description needful for the due performance of the work and render all due and sufficient facilities to the Engineer for the proper inspection of the work.

The Engineer may require the contractor to dismiss any workman or workmen who may be incompetent, uncivil, or abusive: the workmen and contractor only being admitted to the grounds for the purpose of proper execution of the work.

L. The Contractor will be required to use local manpower as much as possible for the work under this contract.

TI.28 PROJECT SUPERVISION

M. The contractor shall, during the whole of the contract, provide an on-site Project Superintendent, (the individual of which is to be mutually agreed upon by the Contractor and Contract Administrator), who shall be responsible for and have authority over all work performed under this Contract, or extension to this Contract.

N. The Project Superintendent shall be fully conversant in the terms and requirements of the Contract Documents, all Provincial and Municipal Health and Safety Regulations, OPSS, and OPSD, and any other specification referred to in the Contract Documents.

O. The Project Superintendent shall remain on site at all times that work is being performed whether by the Contractor or Subcontractor.

P. Replacement of the Project Superintendent is strictly forbidden unless prior written approval is obtained from the Contract Administrator.

TI.29 ASSIGNMENT & SUBLETTING

Q. The work, to be performed under this Contract, or any part thereof, shall not be assigned or sublet by the Contractor without the written permission of the Owner. It is further agreed that the said written authority shall not, under any circumstances, relieve the Contractor of their liabilities and obligations under this Contract.

TI.30 PROJECT SCHEDULE

R. Time is of the essence on this project. Hours of work will be a minimum of 8 hours per day, 5 days per week, Monday to Friday. Any additional expenses, including overtime, to meet this schedule and completion date will be the responsibility of the Contractor and are to be included in the Contractor's Tender Price.

S. Work must begin as soon as possible after award of contract, no later than **April 20th, 2026,** with completion date of **July 31st, 2027.** Council intends to award the project at their March 16th, 2026 regular meeting of Council.

T. In order to expedite construction, the Contractor shall attend a Construction Prestart meeting with the Town of Blind River, at the Town of Blind River Municipal Office on April 1st, 2026 at 1:30pm.

U. In-water works shall commence no sooner than July 16, 2026, with a completion date of August 31, 2026 for all in-water works. In-water works may not occur outside of this period.

V. Concrete works may require cold weather protection, which is the responsibility of the contractor to provide.

W. Prior to the commencement of construction, the Contractor will complete and submit to the Engineer, a detailed construction schedule and a work methodology for review by the Engineer. The Contractor will not be allowed to commence construction unless this plan has been submitted to the Engineer for review. It will be the Contractors responsibility to update the schedule at regular intervals as required to ensure that it is current with construction operations

TI.31 CLEANING UP

X. After all work is completed, the site of the work shall be cleared of all remaining materials, waste, etc., and left in a neat and tidy condition to the satisfaction of the Owner and Engineer.

TI.32 DRAWINGS & SPECIFICATIONS

Y. The drawings and specifications form a part of the official contract. One complete copy of all contract documents in good order shall be kept by the Contractor at the site of work.

Z. The Engineer may furnish additional drawings to clarify the work; such drawings shall become part of the contract documents.

TI.33 CONDUCT OF CONTRACT

AA. During the course of the execution of the contract, should any discrepancies appear, or differences of opinion or misunderstanding arise as to the meaning of the contract, or of the specifications, or as to the due and proper execution of the work, or as to any other questions or matters arising out of the contract, the same shall be determined by the Engineer, whose decision shall be final and binding upon all parties concerned, and from it there shall be no appeal.

TI.34 LIABILITY INSURANCE

BB. The Contractor shall at their own expense, procure and maintain liability insurance in accordance with GC6.0 of the General Conditions of OPSS MUNI 100 and the requirements set out below. The insurance shall be entirely comprehensive for all phases of the work pertaining to this contract.

a. Contractor's Public Liability and Property Damage for bodily injury or property damage, not less than $5,000,000.00.
b. Automobile Public Liability and Property Damage for bodily injury or property damage, not less than $5,000,000.00.
c. Have a limit of not less than $5,000,000.00 inclusive for any one occurrence.
d. Be Comprehensive Liability Insurance covering all operations and liability assumed under contract with the Municipality.
e. Not contain any exclusions or limitations in respect of shoring, underpinning, raising or demolition of any building or structure or subsidence of any property, structure subsidence of any property, structure or land from any cause.
f. Include insurance against liability for bodily injury and property damage caused by vehicles owned by the contractor and used on the work, and in addition, shall include insurance against liability for bodily damage caused by vehicles not owned by the contractor and used on the work. Each insurance shall have a limit of liability of not less than $5,000,000.00 inclusive for any occurrence. A vehicle shall be as defined in the Highway Traffic Act.
g. Be endorsed to provide that the policy or policies will not be altered, cancelled or allowed to lapse within 30 days prior written notice to the Municipality.
h. Protect the insured from any losses arising out of contractual liabilities and completed operations. The policy shall name the Owner and the Engineer as "additional Insureds" and shall contain a cross-liability clause insuring each person, firm or corporation in the same manner to the same extent as if a separate policy was issued to each, but not so as to increase the limits of the insurance company's liability.
i. Be kept in force for a period of 12 months from the date of substantial performance or until the work is accepted by the Owner and a Final Certificate has been issued, whichever is later.

CC. The deductible amount or amounts in any insurance policy required by the Corporation pursuant to this contract shall be subject to the approval of the Corporation. In the event the Corporation does not accept the deductible amount as proposed by the Contractor, the Contractor shall provide insurance with a deductible amount acceptable to the Corporation.

DD. The Contractor shall indemnify and save harmless the Owner and the Engineer from and against all claims, demands, loss, damages and costs resulting directly or indirectly from the performance of the work.

EE. The certificate(s) of insurance and copies of insurance policy(ies), each naming the Owner and the Engineer as “additional Insureds”, must be filed with the Town Clerk upon execution of the Contract.

TI.35 WORKPLACE SAFETY & INSURANCE BOARD

FF. The **Successful Tenderer** shall furnish evidence of compliance with all requirements of the Workplace Safety & Insurance Act of Ontario. Such evidence shall include a Certificate of Good Standing issued prior to the execution of the contract, and further certificates issued prior to the release of the payment recommendations.

TI.36 RENEWAL OF INSURANCE AND WSIB

GG. The **Successful Tenderer** will provide proof of valid Insurance and WSIB on each and every anniversary date of the policy during the life of this or any other contract with the Town of Blind River. Verification is to be sent to the Director of Public Services, Town of Blind River, 11 Hudson Street, Blind River, Ontario P0R 1B0.

TI.37 OCCUPATIONAL HEALTH AND SAFETY ACT

HH. For purposes of the Occupational Health and Safety Act, the Contractor for this project will be designated as the Constructor and will have the responsibilities of the Constructor as set out in the current Act and its Regulations.

II. To this end the Ministry of Labour shall be notified of the commencement of work on the project, with copies of such notification to be forwarded to the Engineer.

JJ. The Contractor will agree to take responsibility for any health and safety violations as well as the cost to defend any charges as a result of any violation.

KK. The Contractor will be required to furnish a copy of their Health & Safety Policy and proof of orientation of their staff.

TI.38 STATUTORY DECLARATION OF PAYMENTS, LIENS & LIABILITIES

LL. Prior to the release of the Construction Act Holdback, the Contractor shall be required to complete a "Statutory Declaration of Payments, Liens and Liabilities" form.

TI.39 ENGINEER’S AUTHORITY

MM. The Engineer may supervise all the work to the extent of ensuring the fulfillment of the contract and the completion of the work in accordance with the plans and specifications.

NN. The Engineer shall determine the quantities of the several kinds of work which are to be paid for under contract and determine all questions relating to the said work and construction thereof. The Engineer shall in all cases decide every question which may arise relative to the performance of the contract, and their estimate and findings shall be final.

OO. The Engineer shall, within a reasonable time, render a decision on all claims by the contractor and all questions which may arise relative to the performance of the work, or the interpretation of the contract. The contractor shall at all times and at their own expense furnish all reasonable aid and assistance required by the Engineer or any Inspector for the proper inspection and examination of the work or part thereof.

PP. The contractor, at their own expense, shall furnish samples for testing when required and shall furnish all reasonable facilities for the inspection of the material and workmanship. The contractor shall obey the directions and instructions of any Inspector and they shall be made in writing at the request of the Contractor.

QQ. Notwithstanding any inspection that the Corporation might carry out, the failure of the Engineer or the Inspector to condemn or object to any defective work or material shall not constitute a waiver of any specifications of the approval or acceptance of such defective work or material and, except as otherwise provided herein, the contractor shall be and remain liable for such defective work or material and any loss, costs, charges, or expenses in connection therewith.

TI.40 NOTICE TO THE ENGINEER

RR. The contractor must notify the Engineer of their intention to begin work a minimum of two weeks prior to start of work.

TI.41 POWER OF OWNER TO COMPLETE WORK

SS. Should the contractor become insolvent or at any time refuse to or neglect to supply sufficient properly skilled workers or materials of the proper quality, or fail in any respect at any time to prosecute the work with promptness or diligence, or fail in the performance of any agreements herein contained, such refusal, neglect, or failure being certified by the Engineer, the Owner shall be at liberty after three days written notice to the contractor to provide any such labor or materials, and to deduct the cost thereof from any money then due under the contract or thereafter to become due under the contract to the contractor. If the Engineer should notify the Owner that such refusal, neglect, or failure is sufficient grounds for such actions, the Owner shall also be at liberty to terminate the employment of the contractor for said work and to enter upon the premises and take possession for the purpose of completing the work under the contract, all materials, tools, and appliances thereof and employ any other persons to furnish the work.

TT. In case of any discontinuance of the employment of the contractor, they shall not be entitled to receive further payments under the contract until the said work will be wholly finished, at which time, if the unpaid balance of the amount to be paid under the contract shall exceed such unpaid balance the contractor shall pay the difference to the Owner. The expense incurred by the Owners as hereinafter provided either for furnishing materials or for finishing work, and any damage incurred through such default shall be audited and certified by the Engineer whose

certificate shall be conclusive upon all parties.

TI.42 CONTRACTOR'S RESPONSIBILITY FOR DAMAGES

UU. If The Contractor, agents, and all workers and persons employed by him/her, or under his/her control, including subcontractors, shall use due care that no person or property is injured and that no rights are infringed upon in the execution of the work, and the Contractor shall be solely responsible for all damages by whomsoever claimable in respect of any injury to persons or to lands, buildings, structures, fences, livestock, trees, crops, roadways, ditches, drains and water courses whether natural or artificial, or property of whatever description, and in respect of any infringement on any right, privilege, or work or any part thereof, or by any neglect, misfeasance or nonfeasance on the Contractor's part or on the part of any of their agents, workers, or persons employed by him/her, or under his/her control, including subcontractors and shall bear the full cost thereof, and shall at his/her own expense make such temporary provisions as may be necessary to ensure the avoidance on any such damage, injury, or menace to the persons and owners the uninterrupted enjoyment of all their rights, in and during the performance of the work, and the Contractor shall indemnify and save harmless the owners from and against all claims, demands, loss, costs, damages, actions, suits or other proceedings by whomsoever made, brought, or prosecuted in any manner based upon, occasioned by, or attributed to any such damage, injury, or infringement.

VV. Notwithstanding the indemnity provision contained in this tender, where in the opinion of the Director of Public Services, the Contractor has failed to rectify any damage, injury, or infringement or has failed to adequately compensate any person for any damage, injury, or infringement for which the Contractor is responsible under this Contract, the Corporation, following notice in writing to the Contractor of its intention to do so, may withhold payment of monies due to the Contractor under this or any other contract until the Contractor has rectified such damage, injury, or infringement, or has paid adequate compensation for such damage, injury, or infringement provided however that the Corporation will not withhold such monies where there is a reasonable disagreement with respect to the rights of the party affected and the Contractor has given such person a reasonable time in which to take court action to establish the validity of the claim.

TI.43 FORFEITURE OF CONTRACT

WW. In the event that the Contractor fails to carry out any of the obligations, covenants, and terms herein provided, whether by reason of strikes, force majeure, bankruptcy or insolvency, or for any reason, the Town may cause the operation to be carried out with its own or other forces and may charge the cost for so doing to the Contractor as against money owing to the Contractor or from the bond herein referred to.
If the Contractor:

- neglects or refuses to sign an agreement within seven (7) days of being advised in writing that their bid has been accepted;
- neglects or fails to commence Infrastructure Services of the date specified in the agreement;
- becomes bankrupt or insolvent or compound with their creditors;
- commits any act of insolvency;
- transfers, assigns, sublets or attempts to transfer, assign or sublet this contract or any part thereof, without consent of the Director of Public Services;

- fails in the opinion of the Director of Public Services after having been given seventy-two (72) hours written notice to execute the work or any part thereof in a sound and competent manner satisfactory in all respects in strict conformity with the contract. Then in each and every case, after seventy-two (72) hours written notice from the Director of Public Services to the Contractor, the Director of Public Services shall have full right and power, at his/her discretion, without process or action at law, to take over the whole contract, or any part or parts thereof specified in the said notice out of the hands of the Contractor. The Contractor upon receiving notice to that effect, shall vacate possession and give up said Infrastructure Services, on the part or parts thereof specified in the said notice, peaceably to the Director of Public Services, who may either relet the same to any other person or persons, with or without its previously being advertised or may employ workers and provide the necessary plant at the expense of the Contractor or may take any other steps as the Director of Public Services may consider necessary or advisable in order to secure the completion of the said contract to his satisfaction; and the Contractor and their surety in every case shall be liable for all damages, expenditures and extra expenditure, and for all additional cost of the work which may be incurred by reason thereof.

TI.44 GOVERNMENT REGULATIONS AND PERMITS

XX. The Contractor(s) shall comply with all provisions of the rules, regulations and orders of Federal, Provincial, and Municipal Government agencies applicable to the work under this Contract. The Contractor(s) shall co-operate with the Corporation in promptly furnishing any information that may be required by such governmental agencies. It shall be the obligation of the Contractor(s) to keep themselves informed of these governmental rules, regulations, and orders and the Contractor(s) shall make the requirements of this article a part of any subcontract he/she may enter into. In addition, the Contractor(s) shall secure and provide, at their own expense, all other permits that may be necessary under any by-law of the appropriate municipality or any act of the Federal or Ontario Legislature or any regulation made under Federal or Provincial Authority.

YY. The Corporation of the Town of Blind River is in the process of obtaining Permits from the Ministry of Environment, Conservation and Parks (MECP), the Ministry of Natural Resources (MNR), the Department of Fisheries and Oceans (DFO), and Transport Canada. The Contractor will be required to follow the conditions identified on the issued permits, one available, and may also be required to supply Horizontal Directional Drilling (HDD) plans to suppor the permit application. The Contractor shall account for all required permitting support in their bid price for the corresponding tender items.

TI.45 EQUIPMENT INVENTORY

ZZ. The successful bidder on this contract will be required, before commencement of the work, to submit a complete inventory of all their and any Sub-contractors' equipment that is proposed to be used on the project. This information must comply with OPSS.PROV Form 127, latest version, for the Identification of Equipment and will be submitted on the form provided in these documents. Force account payments will not be processed until this form is completed to the Engineer’s satisfaction.

TI.46 INCLEMENT WEATHER

A. There will be no compensation for inclement weather. At the discretion of the Engineer, an extension of time may be granted for any day in which inclement weather conditions prevent the Contractor from proceeding with a controlling operation, in accordance with the Ontario Provincial Standards Municipal General Conditions GC 3.06 of Contract, November 2019.

TI.47 CONTRACTOR'S REPRESENTATIVE ON SITE

A. The Contractor shall, during the whole of the contract, provide an on-site Project Superintendent, (the individual of which is to be mutually agreed upon by the Contractor and Contract Administrator), who shall be responsible for and have authority over all work performed under this Contract, or extension to this Contract. The Project Superintendent shall be fully conversant in the terms and requirements of the Contract Documents, all Provincial and Municipal Health and Safety Regulations, OPSS, and OPSD, and any other specification referred to in the Contract Documents. The Project Superintendent shall remain on site at all times that work is being performed whether by the Contractor or Subcontractor. Replacement of the Project Superintendent is strictly forbidden unless prior written approval is obtained from the Contract Administrator.

TI.48 PROGRESS PAYMENT AND MONTHLY REPORT

A. The Engineer shall supply the monthly progress payment report. Statutory Holdback will be in the amount of 10% and Warranty Holdback of 3% of the value of work complete.

TI.49 SUBSTANTIAL PERFORMANCE

A. The project will be considered substantially performed when all parts of the contract are completed in accordance with the Construction Act.

TI.50 EXTRA WORK

B. Extra work shall be undertaken as described in subsection GC3.10.02 of the General Conditions.

C. If applicable tender items are provided in other parts of the contract, extra work shall be performed using the appropriate unit prices from these parts.

D. Extra work shall be paid under the contingency allowance.

TI.51 QUANTITY OVER RUNS AND UNDER RUNS

E. Compensation for quantity over runs and under runs shall be as described in GC 8.01.02 of the General Conditions, as may be modified by item specific provisions

TI.52 REJECTED MATERIAL

F. All material that does not meet specifications, as determined by the Engineer, will be rejected and must be removed and replaced. This shall be done at the Contractor's expense.

TI.53 UTILITIES, FENCES, AND PRIVATE PROPERTY

G. The Contractor shall be responsible for the protection of all utilities, fences and private property at the job site during the time of construction.

H. The Corporation and Engineer do not guarantee the location of any underground utility, nor will they pay any penalty if the Contractor accidentally damages any utility. The Contractor is solely responsible for the preservation of all utilities. The Contractor shall locate and preserve all utilities and all damages are solely the Contractor's responsibility.

I. The Contractor shall be responsible for the temporary support of all existing underground or aerial utility plant during construction of the Works. Any costs associated with the support of such utilities will be considered to be included in the unit prices for the various items of work and no additional compensation will be considered.

J. The Contractor shall, at all times, provide the respective utility companies with access to the work site as may be required. On direction of the Utility the Contractor will be required to have the Utility provide support to utility poles during excavation operations adjacent to the poles.

K. The Contractor shall, at all times, follow the requirements outlined in Enbridge's Third-Party Requirements in Vicinity of Natural Gas Facilities Standard, 2024.01.31.

TI.54 LAYOUT

L. The Contractor will be responsible for the layout of all lines and grades from plans. The benchmark to be utilized on this project is identified on the contract drawings and shall be verified by the Contractor prior to completing layout. From this benchmarks and points of reference, the Contractor will do their own setting out. The setting out by the Contractor shall include but shall not be limited to the preparation of grade sheets, the installation of centre line stakes, grade stakes, offsets, site rails and screeds to the satisfaction of the Engineer and shall be included in the unit prices bid in the Form of Tender.

M. The Contractor shall also be responsible for the true and proper setting out of the works and for the correctness of the position, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments and labour in connection therewith. The Contractor shall not be responsible for the correctness of the information supplied by the Engineer as herein provided for. If at any time during the progress of the works any error shall appear or arise in the position, levels, dimensions, or alignment of any part of the works, the Contractor shall, at their own expense, rectify such error to the satisfaction of the Engineer, unless such error is based on incorrect data supplied in writing by the Engineer. The checking of the setting out of any line or level by the Engineer shall not in any way relieve the Contractor of their responsibility for the correctness thereof and the Contractor shall carefully protect and preserve all benchmarks, stakes and other things used in setting out the works.

N. The contractor shall establish control lines and levels for construction of work providing a minimum of three (3) consecutive reference points not exceeding 15 metres apart, or at closer spacing as required or directed by the Engineer, for each section of work. Control lines and grades by use of lasers or other methods may be used if approved by the Engineer.

O. The Contractor shall not proceed with any work unless all reference points and levels are in place along a section of work under construction.

TI.55 ENVIRONMENTAL CONTROLS

P. The Contractor shall ensure that no detrimental environmental effects occur as a result of the work. The Contractor shall follow all Municipal, Provincial and Federal Acts and Regulations during the performance of the work. The Contractor shall monitor the project to ensure compliance with environmental conditions of construction. The Contractor shall ensure that sediment and other deleterious material do not gain entry to watercourses by means of cofferdams, turbidity curtains and any other means acceptable to the Engineer.

Q. All activities, including equipment maintenance and refueling, shall be controlled to prevent entry of petroleum products or other deleterious substances, including any debris, waste, rubble or concrete material, into a water body or storm sewer system. Any such material, which inadvertently enters a water body or storm sewer system, shall be removed by the Contractor, at their own expense, in a manner satisfactory to the Contract Administrator.

R. Construction material, excess material, construction debris and empty containers shall be stored away from water bodies and banks of water bodies.

S. Sediment laden or turbid water generated from activities such as excavation dewatering shall be discharged into a proper sediment containment system for settling and filtration.

T. In the event that the Contract Administrator determines that controls are unacceptable, the Contractor shall cease such operations as identified by the Contract Administrator, which are determined to be causing the entry of deleterious material into water bodies. Such operations shall remain suspended until otherwise directed by the Contract Administrator in writing. This will not require the cessation of work for such essential operations as continuous concrete pours for structures, unless otherwise directed by the Contract Administrator.

U. All erosion and sediment control measures shall be integrated with a construction operation schedule as determined by the Contractor. Operations in any sensitive area shall not be commenced until temporary erosion and sediment control measures have been installed.

V. Erosion and sediment control measures shall accommodate other aspects of the work including, but not restricted to, the following:
   a) Work area requirements, including equipment access, operation and storage, and material supply utilization and storage.
   b) Surface drainage from outside, through and around the work.
   c) Areas of disturbed soil and soil stockpiles.
   d) Means of access to erosion and sediment control measures requiring maintenance.
   e) Constraints that may be specified elsewhere in the contract.
   f) Protection of completed portions of the work.

W. All vegetated cover not specified for removal shall be preserved in order to minimize erosion and sedimentation.

X. The Contractor shall monitor the erosion and sediment control measures and if the measures are found to be ineffective, the Contractor shall immediately make changes to the measures to control erosion and sediment.

Y. Temporary erosion and sediment control measures shall be kept in place and maintained until all work within a sensitive area has been completed and stabilized. Temporary control measures shall be removed at the completion of the work but not until permanent erosion control measures, as specified in the contract have been established.

TI.56 IDENTIFICATION OF LOCAL REGULATORY AUTHORITIES

The following is provided for information only, to facilitate contact with and notification to regulatory authorities as specified in the Contract Documents:

Regulatory Authority	**Notification Requirement**
MOECP: Spills Action Centre (SAC) 1-800-268-6060	For notification of a spill to the environment under the Environmental Protection Act
Municipality: Town of Blind River (705) 356-2251	For notification of a spill to the environment under the Environmental Protection Act
MOECP: Sault Ste. Marie District Office (705) 942-6354 1-800-263-1035	For Waste Management Approval under the Environmental Protection Act
MNRF: Blind River Area Office (705) 949-1231	For notification of the release of a deleterious substance to a watercourse under the Fisheries Act
DFO: Environmental Response 1-800-265-0237	For notification of the release of a deleterious substance to a watercourse under the Fisheries Act
Local Police: OPP – Blind River (705) 356-2244	For notification of a Dangerous Occurrence involving dangerous goods under the Transportation of Dangerous Goods Act

TI.57 GEOTECHNICAL INFORMATION

Z. A geotechnical program has been undertaken for the project with the full geotechnical report provided as additional information to the contract. The report provided is for information only to indicate the anticipated ground conditions, however no reliance shall be made upon it by the Contractor. The Contractor shall make their own determination and interpretation of the ground conditions across the site and base their bids accordingly.

TI.58 EXCESS SOILS

AA. “O.Reg. 406/19, On-Site and Excess Soil Management” is applicable to this project.

BB. The Contractor shall be responsible for the management and disposal of all excess excavated

materials from the works. Granular and rock excavation materials shall be delivered to the Town's Boom Camp Road Pit. Suitable native materials shall be stockpiled onsite for reuse as backfill as required, with excess native materials delivered to the Town of Blind River Municipal Landfill located at 1182 Highway 17, and left in a neat and uniform manner.

CC. The Contractor must discuss with the Town Foreman in advance to identify the locations for disposal at the respective sites, and materials shall be levelled and left in a neat and uniform manner acceptable to the Town Foreman. Upon completion of the hauling, or at any time deemed necessary by the Owner or Contract Administrator, the delivered materials shall be piled-up with a front-end loader or equivalent to minimize occupied space. End dumped piles will not be considered as satisfactory permanent stockpiles.

DD. At a minimum, the Contractor will be responsible for tracking all truck loads of material with time, date, stationing and receiving location information, based on truck box measurements. Other tracking measures may be required to ensure compliance with the regulations and will be the responsibility of the Contractor. The Contractor will also be responsible for securing the applicable property release forms in accordance with the regulations and OPSS.MUNI 180.

TI.59 AS-CONSTRUCTED DATA

EE. The Contractor shall record as-constructed data of all installations, both above and below grade to 3cm combined horizontal & vertical accuracy and provide to the Contract Administrator at the end of construction. Data collection shall be in the same Horizontal and Vertical Datum as the project control. Control points outside of the project limits, used for preparation of the design plans will be provided to the Contractor. Any transferring of control information to site benchmarks will be the responsibility of the Contractor. Any costs associated with establishing site control as well as collection and delivery of data shall be considered to be included in the unit prices for the various items of work and no additional compensation will be considered.

TI.60 NO NIGHT WORK

FF. No work shall occur between sunset and sunrise for the entire duration of the Contract, unless otherwise approved by the Owner.

TI.61 MIGRATORY BIRD PROTECTION - GENERAL

GG. The Contractor shall not destroy active nests (nests with eggs or young birds), or wound or kill birds, of species protected under the Migratory Birds Convention Act, 1994 and/or Regulations under that Act. When active nests are encountered the Owner's Engineer must be contacted.

TI.62 DEWATERING

HH. The Contractor shall be responsible for any dewatering that may be required to complete the works. Any costs associated with dewatering shall be considered to be included in the unit prices for the various items of work and no additional compensation will be considered.

TI.63 DUST CONTROL

II. The Contractor shall be responsible for any dust control that may be required to complete the works. Any costs associated with dust control shall be considered to be included in the unit prices for the various items of work and no additional compensation will be considered.

TI.64 EXISTING SIGNAGE

JJ. It shall be the Contractor's responsibility to remove and keep in good condition all signs within the limits of the project. If so directed by the Contract Administrator, any existing sign removed by the Contractor to accommodate construction shall be kept operational by placement on a temporary support. Stop signs, road name signs, municipal address signs (911) and address ranges signs (911) **must** be kept operational at all times.

KK. All signs shall be reinstalled by the Contractor in accordance with the OTM after the work operation is complete. Any costs associated with managing existing signage shall be considered to be included in the unit prices for the various items of work and no additional compensation will be considered.

TI.65 MATERIAL TESTING

LL. TULLOCH will provide QA Material Testing, on behalf of the Owner, however the Contractor will be responsible for coordinating all required testing with TULLOCH's site inspector or TULLOCH's Materials Testing Lab in Sault Ste. Marie. In addition, any inefficiencies on the part of the Contractor, ie. cancelled testing, excessive delays or standbys, small test batches, or failed testing which will require retesting, will be the responsibility of the Contractor and the associated costs will be retained by the Owner from monies owed to the Contractor.

MM. The Contractor shall prepare significant lengths of work requiring concrete testing so to not be incurring testing costs for small concrete pours. Testing costs for small pours that are avoidable will be retained by the Owner from monies owed to the Contractor. The Contractor shall also be responsible for completing their own QC testing per OPSS.

FORM OF TENDER

FT.01 TENDER PRICE

NN. Offer by - Contractor –

Address –

City/Province –

Postal Code –

Date -

To the Corporation of the Town of Blind River

We, the undersigned, having examined the site of the Work, having carefully investigated the conditions pertaining to the Work and having secured all the information necessary to enable us to submit a bona fide tender, and having inspected all the Contract Documents and Drawings, hereby agree to enter into a contract and to perform all the Work in accordance with the Contract Documents and Drawings to the satisfaction of the Engineer for the total tender price of:

_____

_____ ($).

FT.02 CONTINGENCIES

OO. We agree that the tender price includes the contingency sum of **$ 900,000.00** and that no part of this sum shall be expended without the written direction of the Engineer, and any part not so expended shall be deducted from the tender price.

FT.03 QUANTITIES

PP. The tender price is compiled from the Schedule of Tender Prices included hereinafter. The quantities in the schedule being approximate, we agree that the final valuation will be made on the basis of actual quantities measured during and on completion of the Work at the prices in the schedule.

FT.04 ADDITIONS AND DEDUCTIONS

QQ. We agree that the valuation of additions to, and deductions from, the contract shall be made as follows:

1. The unit prices in the Schedule of Tender Prices shall apply where appropriate.

2. If the prices in subsection 1 are not appropriate, valuation will be made by one of the

following methods:

i. The Engineer may ask the Contractor for a quotation for the proposed work.

ii. If the quotation referred to in (i) above is not accepted by the Engineer, payment will be made on a Time and Material Basis according to GC 8.02.05. of the General Conditions.

FT.05 ADDENDA

RR. We agree that we have received addenda ___ to ___ inclusive, and the tender price includes the provisions set out in such addenda.

FT.06 MEETINGS

SS. We agree to attend both the Construction Prestart meeting on April 1st, 2026 at 1:30pm, at the Town of Blind River Municipal Office.

FT.07 COMMENCEMENT

TT. We agree to commence Work onsite no later than **April 20th, 2026,** with the anticipated award date of **March 16th, 2026.**

FT.08 COMPLETION

UU. We agree to expeditiously complete all in-water works within the permitted construction window, with final completion of in-water works occurring no later than August 31st, 2026. All work must be completed prior to July 31st, 2027.

FT.09 LIQUIDATED DAMAGES

VV. We agree that in case all Work called for under the Contract is not finished or completed within the Date of Completion specified aforementioned to or as extended in accordance with subsection GC3.06, Extension of Contract Time, of the General Conditions of Contract a loss or damage will be sustained by the Owner. We agree that the Contractor will pay to the Owner the sum of **$1,500.00** as liquidated damages for each and every working day delay to finish the work beyond the date of completion prescribed. We agree that this amount is an estimate of the actual loss or damage to the Owner which will accrue during the period in excess of the prescribed date of completion.

FT.10 DETAILED CONTRACT PRICE BREAKDOWN

BREAKDOWN OF DIVISIONS 1 – 16 LUMP SUM PRICES (excluding all applicable taxes) to be completed by the successful Contractor only and must be submitted before execution of the contract documents.

DIVISION 1 – GENERAL REQUIREMENTS

Section	Title	Total*
1000	General Requirements	
1110	Summary of Work	
1120	Coordination and Sequence of Work	
1140	Special Project Procedures	
1200	Alternatives	
1300	Administrative Requirements	
1320	CPM Construction Schedule	
1330	Submittal Procedures	
1351	Health and Safety	
1400	Environmental Protection	
1410	Regulatory Requirements	
1420	References	
1450	Quality Control	
1510	Temporary Utilities	
1520	Construction Facilities	
1610	General Equipment Stipulations	
1740	Cleaning	
1750	Disinfection of Water Structures	
1760	Warranty Work	
1770	Closeout Procedures	
1780	Closeout Submittals	
1810	Testing and Commissioning	
1820	Demonstration and Training	
	Total Price for Division 1:	

DIVISION 2 – SITEWORKS

Section	Title	Total*
2137	Bracing and Shoring	
2140	Dewatering	
2150	Turbidity Curtain	
2151	Light Duty Silt Fence Barrier	
2152	Straw Bale Flow Check Dams	
2231	Close-Cut Clearing and Grubbing	
2311	Site Grading and Access	
2315	Excavation, Trenching and Backfilling	
2362	Dust Control	
2480	Installation of Pipeline by Horizontal Directional Drilling	

Section	Title	Total*
2481	Installation of Pipeline by Earth and Rock Trenching	
2511	Watermains	
2530	Sanitary Service Connection, Appurtenances & Cleanout	
2532	Subdrains	
2540	Extruded Expanded Polystyrene Insulation	
2725	Hot Mix Asphalt Paving	
2726	Asphalt Pavement Removal	
2911	Topsoil and Sod	
	Total Price for Division 2:	

DIVISION 3 – CONCRETE

Section	Title	Total*
3100	Concrete Forms and Accessories	
3200	Concrete Reinforcement	
3252	Waterstops	
3300	Cast-in-Place Concrete	
3410	Structural Precast Prestressed Concrete	
3600	Grout	
3612	Equipment Anchor Bolt Epoxy Grout	
	Total Price for Division 3:	

DIVISION 4 – MASONRY

Section	Title	Total*
4050	Masonry Procedures	
4051	Masonry Mortar and Grout	
4052	Masonry Anchorage and Reinforcing	
4053	Masonry Accessories	
4211	Brick Unit Masonry	
4220	Concrete Masonry Units	
	Total Price for Division 4:	

DIVISION 5 – METALS

Section	Title	Total*
5120	Structural Steel	
5500	Metal Fabrications	
5510	Metal Stairs and Ladders	
5550	Anchorage in Concrete and Masonry	
	Total Price for Division 5:	

DIVISION 6 – WOOD AND PLASTICS

Section	Title	Total*
6101	Rough Carpentry	
6310	Prefabricated Wood Roof Trusses	
6610	Fibreglass Reinforced Plastics	
	Total Price for Division 6:	

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

Section	Title	Total*
7110	Sheet Waterproofing Membrane	
7160	Sheet Vapour Retarders	
7212	Board Insulation	
7213	Batt and Blanket Insulation	
7270	Self-Adhered Air Vapour Barrier Membrane	
7311	Asphalt Shingles	
7460	Fiber Cement Siding	
7463	Aluminium Soffits and Trim	
7620	Sheet Metal Flashing and Trim	
7840	Fire Stopping	
7900	Joint Sealants	
	Total Price for Division 7:	

DIVISION 8 – DOORS AND WINDOWS

Section	Title	Total*
8110	Steel Doors and Frames	
8200	FRP Doors and Frames	
8710	Door Hardware	
8800	Fire-Rated and Safety Glass	
	Total Price for Division 8:	

DIVISION 9 – FINISHES

Section	Title	Total*
9255	PVC Wall and Ceiling Liner	
9672	Epoxy Coating - Medium	
9900	Paint	
	Total Price for Division 9:	

DIVISION 11 – EQUIPMENT

Section	Title	Total*
11000	Equipment General Requirements	

Section	Title	Total*
11090	Identification and Labelling	
11100	Misc Piping and Accessories Installation	
11101	Piping Valves and Fittings	
11170	Pipeline Pressure and Leakage Testing	
11190	Pipe and Valve Supports	
11210	Vertical Turbine Pumps	
11280	Fabricated SS Sluice Gate	
11290	Valve and Gate Actuators	
11340	Intake Screen and Air Backwash System	
11350	Stationary Screens	
11422	Sample Pump	
11530	Chemical Metering System and Storage	
11540	Chemical Pipes, Valves and Fittings	
	Total Price for Division 11:	

DIVISION 13 – CONTROL & INSTRUMENTATION

Section	Title	Total*
13100	Control & Instrumentation	
13560	Instrumentation General Requirements	
13562	pH Analyzer	
13563	Pressure and Level Instruments	
13564	Miscellaneous Instrumentation and Accessories	
13565	Temperature and Turbidity Instruments	
13566	Magnetic Flow Meters	
13567	Chlorine Residual Analyzer	
13590	Network Cabling Equipment	
	Total Price for Division 13:	

DIVISION 14 – CONVEYING EQUIPMENT

Section	Title	Total*
14310	Hoists	
	Total Price for Division 14:	

DIVISION 15 – MECHANICAL

Section	Title	Total*
15010	Mechanical General Requirements	
15020	Systems Verification	
15043	Balancing	
15044	Commissioning	
15090	Supports, Anchors and Seals	
15100	Basic Materials and Methods	

Section	Title	Total*
15170	Meters and Gauges	
15184	Refrigerant Piping	
15260	Thermal Insulation for Piping	
15270	Thermal Insulation for Ductwork	
15305	Portable Fire Extinguishers	
15401	Plumbing General	
15412	Domestic Water Supply Piping	
15413	Drainage, Waste and Vent Piping	
15430	Plumbing Specialties and Accessories	
15440	Plumbing Fixtures and Trim	
15450	Plumbing Equipment	
15760	Electric Heaters	
15770	Room Air Conditioning Units	
15810	Ductwork and Accessories	
15820	Air Distribution Equipment	
15900	HVAC Controls	
15955	Piping Leakage Testing	
	Total Price for Division 15:	

DIVISION 16 – ELECTRICAL

Section	Title	Total*
16010	Electrical General Requirements	
16015	Electrical System Analysis	
16051	Installation of Cables in Ducts and Trenches	
16061	Grounding – Primary	
16062	Grounding – Secondary	
16090	Equipment Identification	
16111	Cable Tray Systems	
16122	Wires and Cables 0-1000V	
16131	Splitters, Junction, Pull Boxes & Cabinets	
16132	Outlet Boxes, Conduit Boxes & Fittings	
16133	Conduits, Conduit Fastenings & Fittings	
16141	Wiring Devices	
16222	AC Induction Motors	
16223	Motor Starters to 600V	
16224	Variable Frequency Drives to 600V	
16225	Motor Control Centre (MCC)	
16231	Diesel Electric Generating Unit	
16271	Dry Type Transformers	
16301	Automatic Transfer Switches	
16400	Basic Electrical Equipment & Materials	
16412	Moulded Case Circuit Breakers	
16414	Disconnect Switches – Fused & Unfused	
16441	Panelboards Breaker Type	

Section	Title	Total*
16505	Lighting Equipment	
16531	Exit Lights	
16536	Emergency Lighting Units	
16671	Surge Protective Devices	
	Total Price for Division 16:	

FT.11 SCHEDULE OF TENDER PRICES

* Denotes a "**MANDATORY**" field.

Do not enter $0.00 dollars unless you are providing the line item at zero dollars to the Owner.

If the line item and/or table is "**NON-MANDATORY**" and you are not bidding on it, leave the table and/or line item blank. Do not enter a $0.00 dollar value.

SUMMARY OF DIVISIONAL LUMP SUM PRICES

The Bidder shall complete the divisional pricing table below in its entirety. Where a dollar value of zero is inserted on any given line, the Bidder shall be deemed to have included the amount for the applicable division in the total lump sum price.

Line Item	Divisions 1 – 16	Total*
1	Division 1 – General Requirements	
2	Division 2 – Siteworks	
3	Division 3 – Concrete	
4	Division 4 – Masonry	
5	Division 5 – Metals	
6	Division 6 – Wood and Plastics	
7	Division 7 – Thermal and Moisture Protection	
8	Division 8 – Doors and Windows	
9	Division 9 – Finishes	
10	Division 11 – Equipment	
11	Division 13 – Control & Instrumentation	
12	Division 14 – Hoisting Systems	
13	Division 15 – Mechanical	
14	Division 16 – Electrical	
	Subtotal:	

MISCELLANEOUS TABLE

The Bidder agrees that they are not entitled to payment of Miscellaneous items, except for additional work carried in accordance with the Contract as directed by the Owner and/or Consultant and only to the extent of such additional work as directed by the Owner and/or Consultant.

Item No.	Description	Unit of Measure	Estimated Quantity	Unit Price	Total*
1	Supply, erect and removal of four Project Construction Signboards and other signage around construction site	Lump Sum	1		
2	Cost of 100 per cent Performance Bond and 50 per cent Labour and Material Payment Bond and insurance policies, including all subcontractor bonds as specified in the Contract	Lump Sum	1		
3	Mobilization and Demobilization	Lump Sum	1		
				Subtotal:	

MISCELLANEOUS ALLOWANCE TABLE

The Bidder agrees that they are not entitled to payment of Miscellaneous Allowance items, except for additional work carried in accordance with the Contract as directed by the Owner and/or Consultant and only to the extent of such additional work as directed by the Owner and/or Consultant.

Item No.	Specification Number	Description	Unit of Measure	Estimated Quantity	Unit Price	Total*
2	Section 01025-1.7.8.1	Redline Drawings as per Section 01780	Lump sum	1	$ 75,000.00	$ 75,000.00
3	Section 01025-1.7.8.2	O&M Manual as per Section 01780	Lump sum	1	$ 25,000.00	$ 25,000.00
4	NA	Allowance for Utilities Coordination	Lump sum	1	$ 50,000.00	$ 50,000.00
5	NA	Contingency Allowance	Lump sum	1	$ 900,000.00	$ 900,000.00
					Subtotal:	$ 1,150,000.00

PROVISIONAL TABLE

The Bidder agrees that they are not entitled to payment of Provisional items, except for additional work carried in accordance with the Contract as directed by the Owner and/or Consultant and only to the extent of such additional work as directed by the Owner and/or Consultant.

Item No.	Item Name	Specification Number	Description	Unit of Measure	Estimated Quantity	Unit Price	Total*
1	Excavation in all kinds of materials including shoring, removal, and disposal of all surplus and water and all incidentals as specified:	Sections 02140, 02311, 02315, 02480, 02481, 02511, 02530, 02532	Up to 2.0 m deep	m^3	100		
2	Excavation in all kinds of materials including shoring, removal, and disposal of all surplus and water and all incidentals as specified:	Sections 02140, 02311, 02315, 02480, 02481, 02511, 02530, 02532	2.1 m to 4.0 m deep.	m^3	50		
3	Excavation in all kinds of materials including shoring, removal, and disposal of all surplus and water and all incidentals as specified:	Sections 02140, 02311, 02315, 02480, 02481, 02511, 02530, 02532	4.1 m to 6.0 m deep.	m^3	50		
4	Extra disposal cost when surplus excavated material exceeds MOE Table 3 ICC of the "Soil Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" Ministry of the Environment 15 April 2011.	Sections 02140, 02311, 02315, 02480, 02481, 02511, 02530, 02532	N/A	m^3	400		
5	Extra disposal cost when surplus excavated material exceeds MOE Table 3 ICC of the "Soil Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" Ministry of the Environment 15 April 2011 and exceeds O.Reg.347/90 Schedule 4 Leachate Criteria.	Sections 02140, 02311, 02315, 02480, 02481, 02511, 02530, 02532	N/A	m^3	100		
6	Supply place and compact to 100 per cent SPMDD in any excavation or as fill.	Sections 02311, 02315, 02530, 02641	Granular 'A'	m^3	100		
7	Supply place and compact to 100 per cent SPMDD in any excavation or as fill.	Sections 02311, 02315, 02530, 02641	Granular 'B', Type II	m^3	100		
8	Supply place and compact to 100 per cent SPMDD in any excavation or as fill.	Sections 02315, 02532	19mm dia. clear stone	m^3	50		
9	Supply place and compact to 100 per cent SPMDD in any excavation or as fill.	Section 02315	Sand	m^3	50		
10	Supply and place into any excavation or as fill	N/A	0.4 Mpa Unshrinkable Fill Concrete	m^3	50		
11	Concrete in place as specified including formwork and finishing but excluding reinforcing steel	Section 03300	35 Mpa	m^3	50		
12	Concrete in place as specified including formwork and finishing but excluding reinforcing steel	Section 03300	20 Mpa	m^3	50		
13	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Project Manager	Hour	50		
14	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Foreman	Hour	100		
15	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Skilled Labourer	Hour	25		

Item No.	Item Name	Specification Number	Description	Unit of Measure	Estimated Quantity	Unit Price	Total*
16	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Common Labourer	Hour	25		
17	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Heavy Equipment Operator	Hour	25		
18	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Carpenter	Hour	25		
19	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Electrical Foreman	Hour	25		
20	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Electrical Journeyman	Hour	25		
21	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Plumber	Hour	25		
22	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Pipe Fitter	Hour	25		
23	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Painter	Hour	25		
24	Additional labour requirements (labour rates to include payroll, burden, overheard and profit)	N/A	Site Security Personnel	Hour	25		
25	Daylight existing utility using vacuum truck to survey and record the size elevation and location of the utility including backfilling and surface restoration	N/A	Assume 300mm dia. test pits up to 4m deep in paved areas.	days	2		
						Subtotal:	

SUMMARY TABLE

SUMMARY OF DIVISIONAL LUMP SUM PRICES	
MISCELLANEOUS TABLE	
MISCELLANEOUS ALLOWANCE TABLE	
PROVISIONAL TABLE	
Grand Total (exclusive of taxes):	
HST:	
Grand Total (inclusive of HST):	

OFFERED ON BEHALF
OF THE CONTRACTOR

_____
COMPANY NAME

_____
SIGNATURE

CONTRACTOR'S SEAL

_____
SIGNATURE

_____
WITNESS

_____
COMPANY STREET ADDRESS

_____
CITY, PROVINCE, POSTAL CODE

_____
DATE OF OFFER

TENDERER'S EXPERIENCE ON SIMILAR PROJECTS

Similar projects where Tenderer acted as prime or subcontractor.

SUBCONTRACTORS TO BE EMPLOYED

TRADE	SUBCONTRACTOR (Name & Address)	VALUE

TENDERER'S STAFF AND EQUIPMENT

STAFF (Please indicate designated on site superintendent)

EQUIPMENT

EQUIPMENT TO BE USED OWNED OR RENTED

AGREEMENT BETWEEN OWNER & CONTRACTOR

THIS AGREEMENT made ON THE ____ Day of _____ **2026**

by and between:

The Corporation of the Town of Blind River

(hereinafter called the "Owner")

- and

(hereinafter called the "Contractor")

The Owner and the Contractor agree as follows:

ARTICLE 1 - THE WORK

A general description of the work is:

a. Construction of a raw water intake and low lift pumping station, complete with raw water

supply lines to convey raw water from Lake Huron to Martin Street.

b. The Contractor shall, for the prices set out in the Form of Tender and except as otherwise specifically provided, provide at no additional cost to the Owner all and every kind of labour, machinery, plant, structures, roads, ways, materials, appliances, articles and things necessary for the due execution and completion of all the work set out in these Contract Documents and shall forthwith according to the instructions of the Engineer, commence the works and diligently execute the respective portions thereof, and deliver the works complete in every particular to the Owner within the time specified in the Contract Documents.

ARTICLE 2 - CONTINGENCY ALLOWANCE

In the event that the Form of Tender provides for and contains a Contingency Allowance, it is understood and agreed that such Contingency Allowance is merely for the convenience of accounting by the Owner, and the Contractor is not entitled to payment thereof except for extra or additional work carried out by the Contractor as directed by the Engineer and in accordance with the Contract Documents and only to the extent of such extra or additional work.

ARTICLE 3 - CONFLICT

In case of any inconsistency or conflict between the provisions of this Agreement and the Contract Documents and Drawings the Provisions of such documents shall take precedence and govern according to subsection GC2.02 of the General Conditions as detailed following:

a. Agreement
b. Addenda
c. Special Provisions
d. Contract Drawings
e. Standard Specifications
f. Standard Drawings
g. Instructions to Tenderers
h. Tender
i. Supplemental General Conditions
j. General Conditions
k. Working Drawings

ARTICLE 4 - AMENDMENTS

The Contract may be amended only as provided in the Contract Documents.

ARTICLE 5 - CONTRACT PRICE

The Owner covenants with the Contractor that the Contractor having in all respects complied with the provisions of this Contract, will be paid for and in respect of the work the sum of**:**

_____ ($_____)

subject to Article 2 hereof and subject to such additions and deductions as may properly be made under the terms hereof, subject to the provision that the Owner may make payments on account monthly or otherwise as may be provided in the General Conditions attached hereto.

ARTICLE 6 - ADDRESSES FOR NOTICES

Notices in writing between the parties or between them and the Engineer shall be considered to have been received by the addressee on the date of delivery if delivered to the individual, or to a member of the firm, or to an officer of the corporation for whom they are intended by hand or by registered post; or if sent by regular post, to have been delivered within 5 Working Days of the date of mailing when addressed as follows:

The Owner at **The Corporation of the Town of Blind River**
Owner's Name

11 Hudson Street
Street and Number and Postal Box Number if Applicable

Blind River, Ontario, P0R 1B0
Post Office or District, Province, Postal Code

The Contractor at
Contractor's Name

_____
Street and Number and Postal Box Number if Applicable

_____
Post Office or District, Province, Postal Code

The Engineer at **TULLOCH Engineering Inc.**
Engineer's Name

P.O. Box 579, 200 Main Street
Street and Number and Postal Box Number if Applicable

Thessalon, Ontario, P0R 1L0
Post Office or District, Province, Postal Code

ARTICLE 7 - CONTRACT DOCUMENTS

A copy of each of the Specifications, Tendering Information, Form of Tender, List of OPSS & OPSD Applicable to Contract, Supplementary Specifications to Ontario Provincial Standard Specifications, General Conditions of Contract, Supplemental General Conditions of Contract, and Appendices (including Plans C-001 to I-603, ESR, Bathymetric Surveys, Hydrogeological Investigation, Geotechnical Investigations, and the Draft PCN), are made part of this Contract as fully to all intents and purposes as though recited in full herein.

ARTICLE 8 - EXPRESSED COVENANTS

No implied contract of any kind whatsoever by or on behalf of the Owner shall arise or be implied by or inferred from anything in this Contract contained, nor from any position or situation of the parties at any time, it being clearly understood that the express covenants and agreements herein contained made by the Owner shall be the only covenants and agreements upon which any rights against the Owner may be founded.

ARTICLE 9 - TIME OF THE ESSENCE

Time shall be deemed the essence of this Contract.

ARTICLE 10 – CONTRACTOR'S RESPONSIBILITY

The Contractor declares that in tendering for the works and in entering into this Contract they have either investigated for themselves the character of the work and all local conditions that might affect their tender or their acceptance or performance of the work, or that not having so investigated, they acknowledge that their responsibility under the Contract is in no way reduced or limited thereby and, in either case, they are willing to assume and does hereby assume all risk of conditions arising, developing, or being revealed in the course of the work which might or could make the work, or any items thereof, more expensive in character, or more onerous to fulfill, than was contemplated or known when the tender was made or the Contract signed. The Contractor also declares that they did not and does not rely upon information furnished by any methods whatsoever by the Owner or its officers, employees or agents, being aware that any information from such sources was and is approximate and speculative only, and was not in any manner warranted or guaranteed by the Owner.

ARTICLE 11 - SUCCESSION

The Contract shall apply to and be binding on the parties hereto and their successors, administrators, executors and assigns and each of them.

IN WITNESS WHEREOF the parties hereto have hereunto set their hands and seals the day and year first above written or caused their corporate seals to be affixed, attested by the signature of their proper officers, as the case may be.

SIGNED AND DELIVERED
in the presence of:

OWNER

The Corporation of the Town of Blind River
owner's name

_____
signature

_____
name and title of person signing

WITNESS

_____
signature

name and title of person signing

_____
signature

name and title of person signing

CONTRACTOR

_____
contractor's name

_____
signature

_____
name and title of person signing

WITNESS

_____
signature

_____
name and title of person signing

_____
signature

_____
name and title of person signing

LIST OF OPSS & OPSD APPLICABLE TO CONTRACT

The Ontario Provincial Standard Specifications (OPSS) listed below and those referenced therein form part of the Contract Documents. Specifications listed following can be downloaded at: https://www.library.mto.gov.on.ca/SydneyPLUS/TechPubs/Portal/tp/opsViews.aspx

OPSS	VOLUME	ABBREVIATED TITLES	DATE
100	7	General Conditions of Contract	NOV 2019
102	7	Weighing of Materials	NOV 2018
120	7	Use of Explosives	NOV 2019
127	5	Rental Rates for Construction	APR 2024
180	7	Management and Disposal of Excess Material	NOV 2021
201	7	Clearing, Close Cut Clearing, Grubbing	APR 2019
206	7	Grading	APR 2019
310	7	Hot Mix Asphalt	NOV 2017
314	7	Granulars	NOV 2023
401	7	Trenching, Backfilling and Compacting	NOV 2021
403	7	Rock Excavation - Pipelines, Utilities & Structures, Open Cut	NOV 2023
405	7	Pipe Subdrains	NOV 2017
409	7	CCTV Inspection of Pipelines	NOV 2023
410	7	Pipe Sewer Installation in Open Cut	NOV 2018
441	7	Watermain Installation in Open Cut	NOV 2021
442	7	Corrosion Protection of Watermains	NOV 2020
490	7	Site Preparation for Pipelines	NOV 2020
491	7	Preservation & Protection of Existing Facilities	NOV 2017
492	7	Site Restoration	NOV 2020
501	7	Compacting	NOV 2017
506	7	Dust Suppressants	NOV 2017
510	7	Removals	NOV 2018
517	7	Dewatering	NOV 2021
539	7	Temporary Protection Systems	NOV 2021
802	7	Topsoil	NOV 2019
803	7	Sodding	APR 2018
805	7	Temporary Erosion & Sediment Control Measures	NOV 2021

919	7	Formwork	NOV 2021
1001	8	Aggregates - General	NOV 2021
1002	8	Aggregates - Concrete	NOV 2013
1003	8	Aggregates - Hot Mix Asphalt	NOV 2013
1004	8	Aggregates - Miscellaneous	NOV 2021
1010	8	Aggregates - Granular A, B, M & Select Subgrade	NOV 2013
1101	8	Performance Graded Asphalt Cement (PGAC)	NOV 2016
1103	8	Emulsified Asphalt	NOV 2019
1150	8	Hot Mix Asphalt	NOV 2020
1301	8	Cementing Materials	NOV 2018
1302	8	Water	NOV 2019
1350	8	Concrete – Materials and Production	NOV 2023
1605	8	Extruded Expanded Polystyrene Insulation	NOV 2018
1840	8	Non-Pressure Polyethylene (PE) Plastic Pipe Products	NOV 2019
1841	8	Non-Pressure Polyvinyl Chloride (PVC) Pipe Products	NOV 2019
1860	8	Geotextiles	NOV 2018

The Ontario Provincial Standard Drawings (OPSD) listed below and those referred therein form part of the Contract Drawings. Drawings listed following can be downloaded at:
https://www.library.mto.gov.on.ca/SydneyPLUS/TechPubs/Portal/tp/opsViews.aspx

OPSD No.	ABBREVIATED TITLES	REVISION
216.020	Asphalt on Granular Base – Urban Section	2
216.021	Subdrain Pipe – Urban Section	3
219.110	Light-Duty Silt Fence Barrier	3
802.010	Flexible Pipe Embedment and Backfill, Earth Excavation	3
802.013	Flexible Pipe Embedment and Backfill, Rock Excavation	3
1006.010	Sewer Service Connections for Main Pipe Service	4
1101.020	Valve Operator	4
1104.020	Water Service Connection Detail – 32, 38 & 50mm Dia. Sizes	3
1109.011	Cathodic Protection for PVC Watermain	3
1109.025	Waterproofing of Splices	1
1109.030	Insulation for Sewers & Watermains in Shallow Trench	1

Please see the specification package under Division 2.

SUPPLEMENTAL GENERAL CONDITIONS OF CONTRACT

SECTION GC1 INTERPRETATION

GC1.04 Definitions

Subsection GC1.04 is amended by the addition of the following:

"Aggregate" means gravel, sand, clay, earth, shale, stone, limestone, dolostone, sandstone, marble, granite or rock other than metallic ores; slag and clinkers.

"Road Authority" means the body authorized to exercise authority over a road, highway, street or alley.

SECTION GC2 CONTRACT DOCUMENTS

GC 2.01 Reliance on Contract Documents

Notwithstanding the provisions of GC2.01 in the General Conditions the Contractor shall be totally responsible for the location and protection of all existing sewer and watermains, individual services and utility lines regardless if they are shown on the Contract Drawings or not. The existing services and utilities which are shown on the drawings are derived from existing records or surface locates and therefore their location can only be considered to be approximate. Obtain surface locates from all applicable utilities before commencing construction.

SECTION GC4 OWNER'S RESPONSIBILITIES AND RIGHTS

GC4.04 Construction Affecting Railway Property

Paragraph .01 of Subsection GC4.04 is deleted and replaced by the following:

.01 The Contractor shall pay the costs of all flagging and other traffic control measures required and provided by the railway company.

SECTION GC6 INSURANCE, PROTECTION & DAMAGE

GC6.04 Bonding

Pursuant to Subsection GC6.04 Bonding the Contractor shall provide to the Owner a **50% Labour & Material Payment Bond** and **100 % Performance Bond** for performance security. The performance security shall remain in effect until the project has attained Final Completion.

SECTION GC7 CONTRACTOR'S RESPONSIBILITIES AND CONTROL OF THE WORK

GC7.04 Damage by Vehicles or Other Equipment

Paragraph .01 of Subsection GC7.04 is deleted and replaced with the following:

.01 If at any time, in the opinion of the Contract Administrator or the Road Authority, damage is being done or likely to be done to any Roadway or any improvement thereon, outside the Working Area, by the Contractor's vehicles or other Equipment, whether licensed or unlicensed Equipment, the Contractor shall, at no extra cost to the Owner, make changes or substitutions for such vehicles or Equipment, and shall alter loadings , or in some other manner, remove the cause of such damage to the satisfaction of the Contract Administrator and the Road Authority. The Contractor shall, at no extra cost to the Owner, be responsible to rectify the damage done to the Roadway to the satisfaction of the Road Authority.

GC7.06 Maintaining Roadways and Detours

Subsection GC7.06 is amended by the addition of the following:

.12 When roads and/or bridges are to be closed or traffic restricted notify the appropriate fire, police, ambulance, postal and bus authorities giving at least 7 days notice of the closing or restriction. Re-notify the authorities when road or bridges are re-opened or restrictions are lifted.

GC7.11 Notices by the Contractor

Subsection GC7.11 is amended by the addition of the following:

.03 Spills or discharges of pollutants or contaminants under the control of the Contractor, and spills or discharges of pollutants or contaminants that are a result of the Contractor's operations that cause or are likely to cause adverse effects shall forthwith be reported to the Contract Administrator. Such spills or discharges and their adverse effects shall be as defined in the Environmental Protection Act R.S.O. 1990, Chapter E.19. All spills or discharges of liquid, other than accumulated rain water, from luminaries, internally illuminated signs, lamps, and liquid type transformers under the control of the Contractor, and all spills or discharges from this equipment that are a result of the Contractor's operations shall, unless otherwise indicated in the Contract, be assumed to contain PCB's and shall forthwith be reported to the Contract Administrator. This reporting will not relieve the Contractor of his legislated responsibilities regarding such spills or discharges.

GC7.16 Warranty

Subsection GC7.16 is amended by the addition of the following:

.04 To cover rectification costs during the warranty period, the Owner will retain 3**% (three percent)** of the value of Work done, such amount being held back in each progress certificate. Additional monies will be held back as required by provincial statutes. Holdbacks held to cover rectification costs will be retained for a period of twelve months after the date of Completion.

.05 The Contractor shall pay for all additional contract administration, inspection, and material testing costs incurred by the Owner resulting from warranty repair works. Such payments shall be deducted from the warranty holdback amount prior to its release.

SECTION GC8 MEASUREMENT AND PAYMENT

GC8.01.02 Variations in Tender Quantities

Paragraph .01 is amended by deleting 60 Days in the last paragraph and inserting 5 Days.

GC8.02.05.04 Payment for Labour

Clause GC8.02.05.04 is amended by the addition of the following:

.04 Payments in respect of Payroll Burden will be made at the following rates:

(a) Road & Site work - 26 percent of the wages and salary portion of the labour costs.

(b) Structure work - 30 percent of the wages and salary portion of the labour costs.

Where the total labour costs on a Time and Material basis exceeds $ 15,000 per contract for road/structure work, and upon a written request by the Contractor for payment of Payroll Burden in excess of that prescribed herein, the Owner will make payment for work on a Time and Materials basis at the Contractor's actual cost of Payroll Burden as defined.

The Contractor's request shall be accompanied by a confirming statement certified by the Contractor's senior financial officer/auditor. At the Owner's discretion an audit may be conducted in which case the actual Payroll Burden so determined shall be applied to all Time and Material work on the Contract.

GC8.02.09 Liquidated Damages

Pursuant to Subsection GC8.02.09 of the General Conditions, should the Contractor fail to complete the Work in accordance with the Contract and to the satisfaction of the Engineer within the time specified in the Form of Tender, or as amended on the written authority of the Engineer, the Contractor shall pay to the Owner the sum of **$1,500.00** for each working day that the Work shall remain unfinished after such time. Such payments are agreed upon and fixed as liquidated damages that the Owner will suffer by reason of delay and default and are not as a penalty. The Owner may deduct and retain the amount of such liquidated damages out of the monies which may be due or become due to the Contractor under the Contract.

DIVISION 1 – GENERAL REQUIREMENTS

Section No.	Title
01000	General Requirements
01110	Summary of Work
01120	Coordination and Sequence of Work
01140	Special Project Procedures
01200	Alternatives
01300	Administrative Requirements
01320	CPM Construction Schedule
01330	Submittal Procedures
01351	Health and Safety
01400	Environmental Protection
01410	Regulatory Requirements
01420	References
01450	Quality Control
01510	Temporary Utilities
01520	Construction Facilities
01610	General Equipment Stipulations
01740	Cleaning
01750	Disinfection of Water Structures
01760	Warranty Work
01770	Closeout Procedures
01780	Closeout Submittals
01810	Testing and Commissioning
01820	Demonstration and Training

1 GENERAL

1.1 General

1.1.1 This Section identifies the general intent and requirements of the overall Contract to be followed by the Contractor, sub-contractors and all trades involved in completing the work.

1.1.2 The Contractor shall study the Contract Documents to determine the extent of work required by each Section and upon which work of other Sections depend and to co-ordinate scope and extent of work to be performed by each trade.

1.1.3 The Contractor shall within 48 hours of becoming aware of circumstances which may require a clarification or change in the Work, give written notice to the Engineer outlining such circumstances and requesting written directions.

1.1.4 As applicable, maintain in good condition and order on site one copy of the documents approved for building permit, addenda, site instructions, proposed changes, change orders, test reports, manufacturer's installation and application instructions, progress photographs, as-built drawings, approved progress schedules, minutes of site meetings, and other modifications to the Contract Documents.

1.2 Specification Format

1.2.1 Specifications serve to indicate standards, materials and methods for completing the work.

1.2.2 Where Contract Documents do not provide sufficient information for completing installations, comply with manufacturer's written instructions.

1.2.3 The following definitions apply:

.1 **Provide** - To supply and install, complete and in place, including accessories, finishes, tests and services as required to render item so specified complete and ready for use.

.2 **Remove and Dispose** – to physically loosen, undo, unhinge, unbolt, cut and take an item from its location, including all fasteners, and appurtenances related to the item and discard the item and related fasteners and appurtenances at an appropriate facility, unless specifically requested to be salvaged by the Owner.

.3 **Commission** - Start-up and initial operation of equipment as required to demonstrate satisfactory operation of components and entire system including calibration of any control instrumentation as required to maintain operations.

.4 **Drawings Lists or Schedules** of Items are intended to show scope and arrangement of work. For locations of items described refer to such Drawings, Lists or Schedules unless locations are stipulated in the Specifications.

.5 Wherever words "reviewed", "selected", "directed", "designated", "permitted", "inspected", "instructed", "required", "report", "submit", "obtain", "consult", or similar words or phrases are used in the Contract Documents, it shall be understood that "by/to/from/with the Engineer" shall follow.

.6 Where specification sections designate authorities such as "Engineer", “Consultant”, or “Contract Administrator”, these designations shall be taken to mean CIMA Canada Inc. Where standards designate "Owner", these designations shall be taken to mean "LA Development Inc.".

1.2.4 If there is a discrepancy between specifications and drawings or each section, the most stringent drawings, clause or note shall take precedent as per the Engineer’s interpretation.

1.3 Standards

1.3.1 Conform to the latest editions as amended and revised to date of Contract.

1.3.2 If requested provide copy on Site of such standard(s).

1.3.3 Where standards designate authorities such as "Engineer" or “Consultant”, these designations shall be taken to mean CIMA Canada Inc. Where standards designate "Owner" or other such designation, these designations shall be taken to mean LA Development Inc.

1.4 Requirements of Authorities and Agencies

1.4.1 The Contractor shall be responsible for complying fully with the requirements of all Authorities and Agencies that govern any or all of the works under this Contract. These requirements may affect installation and construction methods and may include a written notice to an Authority or Agency prior to the commencement of construction. When a written notice to an Authority or Agency is required, a copy of the notice shall be submitted to the Engineer by the Contractor.

1.4.2 Comply with The Building Code Act including the Ontario Building Code, as amended; and Regulations and by-laws of other authorities having jurisdiction including latest amendments thereto: all hereafter referred to as the Code. Where Code or Contract Documents do not cover a particular, conform to requirements of the National Building Code, as amended, including its related supplements. Where Drawings and/or Specifications exceed Code requirements satisfy such additional requirements.

1.5 Reference Information

1.5.1 The drawings governing alterations to existing works if required were prepared using the following assumptions:

.1 The existing structures were built in accordance with the original contract documents, significant details of which have been reproduced on the drawings.

.2 The workmanship and materials employed on the existing structures were of good quality and the building has not deteriorated significantly.

.3 Bearing walls, structural steel and structural concrete is reasonably true and plumb.

1.5.2 Examine the site and buildings or structures on it. Establish conditions under which the work is to be done, and accept the premises as found upon taking possession of the property. Direct all inquiries to the Consultant.

1.5.3 Existing base horizontal and vertical control points will be provided by the Owner.

1.5.4 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.

1.5.5 Make no changes or relocations without prior written notice to the Engineer.

1.5.6 Report to the Engineer when a reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.

1.5.7 The Owner will replace control points in accordance with the original survey control. The cost of resetting or replacing control points disturbed by the Contractor shall be at the Contractor's expense.

1.5.8 All elevations indicated on the Contract Drawings or Specifications are referred to datum of Geodetic Survey of Canada and to a benchmark established at or near the site of the works.

1.5.9 All general layout required by the Contractor for the purposes of construction shall be carried out by the Contractor. The Contractor shall provide such masts, scaffolds, batter boards, slope stakes, straight edges, templates and other devices as may be necessary to facilitate layout and inspection and construction of the Works within the contract price.

1.5.10 The Engineer will check the Contractor's layout.

1.5.11 Survey Requirements by Contractor:

.1 Record locations, with horizontal and vertical data in Project Record Documents.

.2 Establish lines and levels, locate and lay out the works using appropriate instrumentation.

.3 Stake for grading, fill and topsoil placement and landscaping features.

.4 Stake slopes and berms.

.5 Establish pipe invert elevations.

.6 Stake batter boards for foundations.

.7 Establish foundation column locations and floor elevations.

.8 Establish lines and levels for mechanical and electrical work.

1.6 Subsurface Conditions

1.6.1 Promptly notify the Engineer in writing if subsurface conditions, or any reasonable assumption of probable conditions, differs materially from those indicated in the Contract Documents.

1.6.2 The Engineer or other agents of the Owner will promptly investigate the conditions and the Engineer will advise the Contractor in writing of any necessary changes to the Works.

1.7 Protection and Safety

1.7.1 The Contractor shall undertake the role of the "Constructor" as defined in the Occupational Health and Safety Act.

1.7.2 Ensure that those who handle, and/or are exposed to, or are likely to handle or be exposed to, hazardous materials are fully instructed and trained in accordance with WHMIS requirements.

1.7.3 Protect excavations, trenches and building from damage by rainwater, ground water, backing up of drains or sewers and other water, frost and other weather conditions. Provide sheeting, piling, shoring, pumps, equipment, temporary drainage, protective covering and enclosures. Provide necessary pumps including spare pump for keeping excavations free of water throughout construction period.

1.7.4 Protect active services. Cap inactive services and remove unwanted portions with approval of Engineer.

1.7.5 Protect finished work. Damaged work shall be restored or redone at the Contractor's expense at the discretion of the Engineer.

1.7.6 Protect public and those employed on Work from injury. Mobile equipment when not in use shall have keys removed and locked up in secure location.

1.7.7 Ensure that working conditions for the Owner are not adversely affected by work under this contract.

1.8 Manufacturer's Instructions

1.8.1 Install or erect products in accordance with manufacturer's direct written instructions.

1.8.2 Handle and store materials in accordance with manufacturers' and suppliers' recommendations and to prevent damage to materials during storage and handling.

1.8.3 Notify the Engineer in writing, of conflicts between the specification and manufacturer's instructions, so that the Engineer may establish the course of action.

1.9 Progress Draw Cost Breakdowns

1.9.1 In accordance with Section 01320, Clause 2.2, unless otherwise indicated in the Form of Tender.

1.9.2 Use Table of Contents of the Specification as basis for identifying line items in the breakdown, unless otherwise indicated in the Form of Tender.

1.10 Concealment of Services

1.10.1 Pipes, conduits, service lines and ducts shall be concealed in chases, behind furring or above ceilings, and such items shall not be exposed to view except where they are noted as being exposed to view or reviewed and approved by the Engineer.

1.10.2 Where no ceiling is provided, such items occurring in ceiling spaces may be exposed. In this case, workmanship must be of the highest quality, all lines etc. shall be run straight and true.

1.11 Mobilization and Demobilization

1.11.1 The Vendor must provide for the mobilization/demobilization of the site in accordance with these contract documents.

1.11.2 Comply with the Engineer's and Owner's instructions in regard to the allocation of the mobilization areas of the site; construction fencing, temporary signage, field offices and storage areas, access and parking.

1.11.3 Successful mobilization will generally consist of the following:

.1 Supply and erect all temporary signs, barricades/fences, flashers, delineators, flag persons, and such other protection as may be required to protect the public during construction.

.2 Provide security protection for Site office, plant and stored materials.

.3 Move onto site and set up offices, storage facilities, plant, sanitary facilities, temporary fencing, temporary work areas, temporary hydro and telephone if specified or required by the Contractor to complete the Works.

.4 Provide all necessary access to the project including temporary access as required.

1.11.4 Successful demobilization will generally consist of the following:

.1 Removal of temporary signs, barricades/fences, flashers, delineators, flag persons, and such other protection that was installed at the beginning of the Contract.

.2 Removal of temporary access or work areas, and restoration of damaged surfaces to original condition or better.

.3 Move off site and remove offices, storage facilities, and all temporary or construction plant or facilities and leave the site clean and tidy.

1.11.5 The price entered for this item shall be consistent with the costs involved but shall not, in any event, exceed ten percent (10 percent) of the Total Lump Sum Price.

1.11.6 The payment for mobilization up to a maximum of 60 percent shall be included in the first payment certificate issued for the Contract subject to the Owner or Consultant being satisfied that full mobilization has been carried out. If the Owner or Consultant is not so satisfied, then an adjustment to the payment certificate that reflects the degree of mobilization, in the opinion of the Owner or Consultant, will be made.

1.11.7 The payment for demobilization shall become due following Substantial Performance/Completion of the Works and subject to the Owner or Consultant being satisfied that full demobilization has been carried out. If the Owner or Consultant is not so satisfied, then an adjustment to the payment certificate that reflects the degree of demobilization, in the opinion of the Owner or Consultant, will be made.

1.12 Damage to Existing Utilities and Structures

1.12.1 Obtain the necessary drawings and perform any necessary sub-surface investigations in order to determine the exact location of all existing utility services, structures, underground

pipes, cables, and other similar items. Notify Engineer immediately of any potential conflicts with proposal buried piping and utilities.

1.12.2 The location for existing structures and underground pipes, cables, utilities, and other similar items as shown on the Contract Drawings do not relieve the Contractor of this responsibility.

1.12.3 Take the necessary steps to ensure that no damage is caused to existing structures, buildings, foundations, roads, sidewalks, property, utility services, and other similar items during the progress of the Work.

1.12.4 If any damage is caused, repair and make good such damage at no additional cost within a reasonable time and to the complete satisfaction of the Engineer.

1.13 Occupying the Site

1.13.1 Use only those areas designated by the Owner for the access, except in so far as is necessary for the execution of the Works, and in so doing, do not unnecessarily obstruct the normal traffic of, to, from or about the Site; and do not unreasonably allow any vehicles or materials to stand in front of, or near to, any buildings on the Site or any access thereto.

1.13.2 Areas shown as Contractor's Limits are areas to be used by the Contractor for construction, parking lot, storage and temporary facilities.

1.13.3 All inquiries and deliveries related to the Contractor's activities will be directed to the Contractor's site trailer.

1.13.4 Confine operations within areas designated for construction, storage and access as shown on the Contract Drawings and/or as directed by the Engineer.

1.13.5 Limit access to and from the site as instructed by the Engineer.

1.13.6 Maintain safe access to any existing facilities for the operations staff at all times.

1.13.7 Limit possession of any areas of the Site occupied by operational plant (Restricted Areas) to such times as are necessary for the execution of the works in those areas.

1.13.8 Clearly identify in the schedule when occupation of Restricted Areas or the main work area is required and notify the Engineer in writing when such possession is required at least 10 working days in advance.

1.13.9 Do not occupy or use any of the Restricted Areas for a longer period than is necessary for the execution of any part of the works to be undertaken in those areas. Occupy an area not greater than the minimum required for that part of the works.

1.14 Contractor Use of Premise

1.14.1 Arrange with the Owner and Engineer for storage areas and access to the Works.

1.14.2 Make arrangements with property owners if additional areas are required. Obtain written agreements and submit copies to the Engineer.

1.14.3 Confine operations within working limits for construction, storage and access.

1.14.4 Install and maintain temporary chain link fencing along working and storage areas and access routes.

1.14.5 Carry out the construction of the Works in such a manner that a minimum of inconvenience is caused to the Owner and occupants of properties adjacent to the Works.

1.14.6 Store materials separately on the Site at locations agreed upon with the Engineer, suitably protected to prevent their deterioration or the intrusion of foreign matter. In the opinion of the Engineer, remove any material which has deteriorated or been damaged immediately from the Site at no additional cost to the Owner.

1.14.7 During construction of the facilities, liaise with the Engineer and plant operating staff to schedule work to minimize impacts on plant operations.

1.14.8 Obtain written approval from the Engineer for tie-in work to the existing facilities. Plant operating staff will operate any valve, switch, or other controls on existing facilities.

1.14.9 The contractor shall provide portable washroom facilities to be used by the Contractor's personnel. They are to be maintained by the Contractor in neat and clean condition for the duration of the contract. Washroom facilities shall be located outside the plant's buildings. Contractor forces are under no circumstances to use plant washrooms.

1.14.10 Meter the supply of water, electricity and chemicals for the construction and commissioning of the Works. Meter this supply and reimburse the Owner for all usages at the completion of the Contract.

1.15 Payment

1.15.1 This is a lump sum Contract and payment will be made for work completed during the payment period on a percentage basis of the sum entered in the breakdown of the lump sum price, as approved by the Engineer.

1.15.2 Applications for payment may be made on a monthly basis as the work progresses. The applications should be dated the last day of the payment period and the amounts claimed should be proportionate to the amount of work performed and products delivered to the place of work as of that date.

1.15.3 Applications for payment must be made in accordance with legislation and statutory regulations, including proof of WSIB coverage during the work period and a Statutory Declaration that the previous payment was properly and fairly distributed.

1.15.4 There are no provisions for payment of this section in the Form of Tender. Costs for following the general requirements of the Contract shall be included in the overall Contract price.

1.15.5 Refer to the General Conditions of the Contract for further instructions related to payment.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 The intent of these specifications is to provide for the works herein enumerated to be fully completed in every detail for the purposes designated. It is hereby understood that the Contractor, in accepting the Contract, agrees to furnish any apparatus, appliances, material or labour not herein specifically mentioned or included, but which is found necessary to complete, perfect, and test every requirement written and implied in these specifications, without extra cost to the owner.

1.2 Work Covered by Contract Documents

1.2.1 The work to be done under this Contract, as specified and/or as shown on the Drawings includes the complete supply of all materials, labour and equipment for the construction of utilities and services required for the Blind River WTP New Intake and Low Lift Pumping Station (LLPS) project.

1.2.2 A general description of the proposed requirements for the Blind River WTP raw water intake and LLPS is outlined below:

.1 400 mm diameter HDPE raw water intake, approx. 390 m long, with complete intake screen and protective structure, combined with a conduit running external to the pipe, carrying lines for raw water sampling, sodium hypochlorite dosing, and pressurized air.

.2 New raw water intake well

.3 New Low Lift Pumping Station (LLPS) located east of Blind River Wastewater Treatment Plant (WWTP), housing screen wells, screened water well, low lift wells, a sodium hypochlorite room, and equipment listed below.

.4 Two (2) low lift pumps complete with variable frequency drives (VFD) to supply raw water to the Blind River WTP.

.5 Sodium hypochlorite dosing system in dedicated chemical room, consisting of storage tank and panel mounted dosing pumps & accessories.

.6 Air backwash system, supplied by a vendor and integrated with the intake screen

.7 Two manual screens to be installed in two screen well cells.

.8 Traveling crane with hoists for lifting low lift pumps

.9 Traveling crane with hoists for lifting manual screens for cleaning.

.10 Electrical switchgear, MCC, VFDs, controls and SCADA.

.11 Twin 300 mm diameter watermains leaving the LLPS and connecting to future 300mm watermains at Martin Street.

.12 Outdoor diesel generator set for emergency power supply, complete with integral diesel tank and noise attenuating enclosure.

.13 All process, mechanical and yard piping including all process and mechanical piping inside the LLPS and yard piping out of the LLPS.

.14 HVAC and plumbing systems

.15 The new LLPS design will integrate into the surrounding lands and allow for easy access to the facility.

.16 Site grading and access driveway.

1.2.3 This clause is not intended to define the scope of the contract. Use it only as a general guide to the extent of the work.

1.3 Location of Work

1.3.1 The Blind River LLPS site is located approximately on Martin Street in Blind River, Ontario, east of the Wastewater Treatment Plant.

1.4 Hours of Work

1.4.1 Normal working hours shall be Monday to Friday between 7 am and 7 pm.

1.4.2 The Contractor is advised that night, weekend or holiday work may be required in the Contract. The Owner or Engineer may, where they deem it necessary to speed up the work or deem it necessary or expedient in order to preserve and maintain traffic over or on any street or road, or to restore utility service, order any work to be carried out in whole or in part at night or on two or three shift basis, or on Sundays or holidays, and the Contractor shall have no claim for extra compensation in respect thereof.

1.4.3 The Contractor shall, as far as possible, refrain from work on days which are legal holidays for the Owner. If it is desired to work on any such holiday, the Contractor shall notify the Owner in writing at least four days in advance of such holiday of his intention to work, stating the areas where the work will be conducted.

1.4.4 If the Contractor fails to give such notice in advance of any holiday, such failure shall be considered as an indication that no work requiring the presence of an authorized representative of the Owner is to be done by the Contractor on such a holiday.

1.5 Contract Method

1.5.1 Construct the Works under a single lump sum contract.

1.6 Work by Others

1.6.1 No other contractors are expected to be on site during this Contract.

1.6.2 The Contractor will coordinate all utility Contractors and all testing and commissioning work with the Owners, Staff and Agents.

1.6.3 The Contractor shall at all times cooperate with the Owner, the Owner's Operator and other contractors on site. The Contractor shall maintain time and space separation between the Contractor's forces and other Contractors and Operations Staff for the duration of the project.

1.7 Future Work

1.7.1 There are no provisions for future work in the Contract.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 General Coordination

1.1.1 The Contractor shall develop and finalize the construction sequence so as to minimize impact on operations and water quality, subject to approval of the Engineer and the Owner.

1.1.2 Construct Work in stages to accommodate the Owner's use of the premises during construction (the Wastewater Treatment Plant is located west of the proposed LLPS), as necessary. The raw water intake construction shall take place during permissible in-water works construction windows (refer to Clause 3.3).

1.1.3 Once the intake and LLPS have been commissioned, connection of the new watermains to the existing feedermain supply to the WTP will have to be coordinated to ensure minimum disruption and ensure that the **Source Water Transition Plan** (the water system will transition from a GUDI wells based system to a surface water source system) is followed to minimize impacts to water quality. Work shall be carried out expeditiously to minimize disruptions to the WTP supply and existing WTP operations.

1.1.4 The Contractor will be responsible to ensure adequate coordination of the **Source Water Transition Plan** and Construction and Commissioning Schedule with the Owner and Engineer.

1.1.5 Any shutdowns shall be in strict accordance with the sequence in the Contractor's schedule and shall be carefully coordinated with the Owner, Engineer and Operating personnel to avoid unplanned impacts to the water supply and distribution system.

1.1.6 Prior to shutdown the Contractor must request in writing at least ten working days in advance of the required shutdown. Depending on demand the Owner may require the shutdown to be done at other than normal working hours or postponed to a time more suitable to system operation. The Contractor shall reschedule his work to suit system operation at no additional cost to the Owner.

1.2 Submittals for Review

1.2.1 Provide detailed plans and schedules for all work activities which will create a disruption to or require the participation of Owner Operations.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 General

3.1.1 The Contractor shall take responsibility for carefully coordinating all aspects of the work including all permanent and temporary connections whether identified on the Contract Drawings or not, to successfully complete the Works. Designate a fully qualified individual, as a General Superintendent, to be responsible for directing the progress of this Contract continuously, including the coordination and work of sub-contractors.

3.1.2 Coordinate Progress Schedule and coordinate with the Owner occupancy during construction.

3.1.3 Some equipment or supplies may require lengthy delivery times and as such must be ordered as soon as a notice to proceed is given by the Engineer. The Owner will not entertain extra claims or waive damages as a result of late delivery of such items.

3.1.4 Provide details of works required to implement tie-ins, detailing what services, temporary facilities etc., if any, will be provided by Owner and/or its staff. All other services to be provided by the Contractor.

3.1.5 Provide all necessary temporary pumps, blinds, valves, piping, electrical wiring, controls, and labour incidental to complete the Work. Any temporary equipment must be continuously monitored by the Contractor during construction and be replaced expeditiously upon failure so as to be able to continue with the Work.

3.1.6 Some shutdowns will have to take place outside normal working hours, i.e. nighttime and/or weekends in order to comply with shutdown limitations as described in this Section.

3.1.7 Coordinate scheduling, submittals, and work of the various Sections of the Project Specifications and other requirements of the Contract Documents to ensure efficient and orderly sequence of installation of interdependent construction elements.

3.1.8 Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such elements.

3.1.9 Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.

3.2 Monitoring and Emergency Response

3.2.1 Contractor shall supply appropriate rescue and emergency response resources and plans as required by O. Reg. 628/05.

3.3 Operation/Construction Constraints

3.3.1 The following operation/construction constraints to be considered in scheduling the work.

3.3.2 Construction Constraints:

.1 Permitted construction windows for in-water raw water intake section (DFO, July to August)

.2 Watermains construction: Railway crossing north across site and Trans Canada Highway

.3 Minimum disturbance to nearby commercial and residential area

3.4 Permitted Outages (Not Applicable)

3.5 Suggested Sequence of Construction

3.5.1 This Section is not intended to describe the full extent of the work to be done under this Contract. It is intended to outline the general construction sequence only. The Contractor will be responsible for scheduling the detailed construction of the works within the general sequence.

3.5.2 The Contractor shall schedule his work and conform with the intent of the following requirements, and ample allowance shall be made in the schedule to comply therewith. The following is not intended to imply the Contractor must carry out the work in the exact manner indicated but is intended to indicate the restrictions that shall be imposed **on construction work sequence and to set out the time duration of shutdowns**.

3.5.3 The following outlines the general chronological order in in which construction activities are proposed to take place, upon award of the Contract. This list is not intended to be comprehensive in all activities required to complete the works but is intended to identify the main constraints on the scheduling of construction activities. The construction of the works is proposed to proceed as follows:

.1 Submittal of shop drawings for all critical or long lead items such as, but not limited to low lift pumps, MCC's, standby generator, and control panels.

.2 Mobilization to site and commencement of general site work modification including clearing and grubbing of the site, installation of environmental controls and temporary construction fencing, and installation of temporary access driveway to the new LLPS location. Mobilization to site will also include equipment by the shoreline to undertake the construction of the raw water intake and intake structure.

.3 Construction of the intake and LLPS can be undertaken in parallel. The decisive factor will be the permitted construction windows in-water to minimize impacts on aquatic life.

.4 Cleaning and testing of raw water intake: refer to Intake Specification

.5 Construction of the Low Lift Pump Station (LLPS) building complete with wells, screens, sluice gates, pumps, piping valves and fittings, sodium hypochlorite system, motor control centre, electrical, PLC, heating, ventilation, lighting, and architectural finishes.

.6 Installation of a standby outdoor generator contained in a stand alone, weatherproof, noise attenuated enclosure.

.7 Construction of all yard piping, manholes, drains, and electrical duct banks on the site up to Martin Street.

.8 Construction of twin watermains from Martin Street to tie-in point upstream of existing WTP. Testing and disinfection as applicable. Stub ends for final connection closer to commissioning.

.9 Construction of new access driveway around the facility.

.10 Cleaning and disinfection of the intake well, screen wells, screened water well and low lift wells and associated piping and infrastructure.

.11 Testing and commissioning of the new Intake and LLPS

.12 Operational testing of the low lift pumps using raw water from the lake via intake. Initial water to be pumped to waste. Provide dechlorination and erosion / flood control as required.

.13 Upon successful testing of the low lift pumps, coordinate with Owner and Owner's Operator to make final watermains connection to the tie-in location at Martin Street.

.14 Testing and commissioning of twin watermains in accordance with AWWA Standards.

.15 Prior to delivering surface water from the new low lift pumps to the WTP, the Contractor will ensure coordination of the **Source Water Transition Plan** from the current GUDI groundwater source to surface water source, to ensure treated water quality is produced by the Water Treatment Plant.

.16 Complete (14) fourteen day performance testing of the facility

.17 Make final watermains and electrical connections.

.18 Complete landscaping, hardscaping and restoration of all affected areas and pavement.

3.5.4 Prior to work directly affecting operations of the existing water system, the Contractor shall provide a plan and schedule of activities to occur during the work at least 15 working days before the planned work, for review and approval by the Engineer. The plan by the Contractor shall identify the anticipated durations for the activities that will be required and a schedule of proposed shutdowns. The decision to terminate work will be made, if in the opinion of the Engineer that work is not progressing according to the Contractors timelines, and/or it is evident the work will not be completed in the allowable time.

3.5.5 The exact construction sequence, including all key steps from the **Source Water Transition Plan,** must be developed by the Contractor based on the Contractor's own work plan and projections of the required time required to complete the work. The Contractor may have to stage equipment shutdowns, to accomplish a task, in order to meet the constraints identified herein. The Contractors detailed schedule submitted after award of the Contract shall provide the number of shutdowns and the duration of each shutdown. The Owner and the Engineer reserve the right to adjust the suggested construction sequence based on the water demands in the system at no extra cost to the Contractor, unless the changes will cause undue hardship on the Contractor.

3.6 Contractor Use of Premises and Restricted Areas

3.6.1 The Contractor shall arrange with the Owner for easements for construction, storage and access to all of the Works within the Owner's property line.

3.6.2 Make arrangements with property owners if additional areas are required. Obtain written agreements and submit copies to the Engineer.

3.6.3 Confine operations within easements for construction, storage and access.

3.6.4 Install and maintain adequate security or construction fencing and gates around storage areas or the construction site and maintain during the construction period.

3.6.5 Do not enter upon or occupy with workers, tools or materials any lands other than public streets, roadways, right-of-ways or easements shown on the Contract Drawings except after written consent has been received from the property owner.

3.6.6 The construction of the Works shall be carried out in such a manner that a minimum of inconvenience is caused to the Owner and occupants of properties adjacent to the Works.

3.6.7 Materials shall be stored separately on the Site at locations agreed upon with the Engineer and shall be suitably protected to prevent their deterioration or the intrusion of foreign matter. In the opinion of the Engineer, any material which has deteriorated or been damaged shall be removed immediately from the Site at the Contractor's expense.

3.6.8 The flow in existing drains and ditches shall be maintained by the Contractor at all times at no extra cost to the Owner. During construction of the facilities, the Contractor shall liaise with the Engineer to schedule work to ensure continual flow.

3.6.9 The Owner’s Operating staff will operate any valve, switch, or other control on existing facilities.

END OF SECTION

1 GENERAL

1.1 General Requirements

1.1.1 Existing systems or individual equipment items will be isolated by the Owner. The Contractor is responsible for unwatering, de-commissioning, de-energizing and de-pressurizing as required. Perform all such work in accordance with the shutdown plan submitted by the Contractor and approved by the Engineer. The Owner will operate all valves and gates as required.

1.1.2 Provide details of works required to implement tie-ins, detailing what services, temporary facilities etc., if any, will be provided by Owner and/or its staff. All other services to be provided by the Contractor.

1.1.3 Where piping under this Contract connects to the work of others, connect to the existing piping where it has already been installed or, if not installed, terminate and cap the pipe. Cap all of the abandoned pipes generated from this construction. During the removals, all abandoned pipes and spools shall be blocked by using either blind flanges or caps with couplings.

1.1.4 Do not leave any pipe open to process or storage areas where the flow of liquid or gas may be allowed into other areas, except as planned for and required for work to be done.

1.1.5 Provide temporary supports for all existing electrical conduits/cables.

1.1.6 The Contractor is responsible for the proper and adequate temporary venting of confined spaces. Provide full purging and monitoring of explosive conditions prior to welding or cutting of any piping. Monitor for explosive gases in all hazardous areas prior to and during any work related activities.

1.2 Coordination

1.2.1 Designate a fully qualified individual, as a General Superintendent, to be responsible for directing the progress of this Contract continuously, including the coordination and work of sub-contractors.

1.2.2 Coordinate scheduling, submittals, and work of the various Sections of the Project Specifications and other requirements of the Contract Documents to ensure efficient and orderly sequence of installation of interdependent construction elements.

1.2.3 Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such elements.

1.2.4 Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.

1.2.5 In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 General

3.1.1 The Contractor shall take responsibility for the proper functionality of all devices in the scope, including existing modified devices, at the conclusion of his work. Prior to beginning work and upon the Contractor's request, with five working days' notice, the Owner will demonstrate the functionality of any piece of existing equipment.

3.1.2 Where existing active mechanical, electrical or other services, concealed or exposed, extend through or are within the area to be renovated, include for concealing existing services behind new finishes wherever they would be exposed in new finished areas.

3.1.3 Carefully remove existing fixtures, equipment, construction and finishes shown on the Drawings to be removed employing experienced tradesmen. Salvage, identify and store the Products that are to be reused or delivered to the Owner.

3.1.4 Where mechanical or electrical fixtures and equipment are removed, cut back obsolete piping, ductwork and conduit behind finishes, unless otherwise specified, and cap. Cap piping watertight. Remove obsolete wiring back to its source. Provide blank cover plates on obsolete outlet boxes.

3.1.5 Remove and dispose of the site products not designated for reuse or delivery to the Owner.

3.1.6 Be responsible for and enforce fire protection methods and procedures and adherence to local fire regulations, including requirement of the Occupational Health and Safety Act.

3.1.7 Maintain fire access/control at all times.

3.1.8 Whenever soldering, welding or any open-flame work is performed, ensure the area is suitable for such work, ensure the proper incombustible shields are provided to protect combustible products and materials and have an observer present at all times to ensure adjacent products and materials are not ignited and welding, soldering or open flame work does not produce a hazardous condition.

3.1.9 Ensure the existing fire protection and alarm systems are not obstructed, shutoff or made inactive at any time. Do not use any fire hydrant, standpipe, or hose system for other than fire protection purposes.

3.1.10 Open fires and burning of rubbish are not permitted on the site.

3.1.11 Smoking is not permitted in hazardous areas or any other buildings on the Plant Sites.

3.1.12 Comply with Chapter 321 of OHSA Regulations for Construction Projects.

3.1.13 Remove any potential designated substances and comply with the following:

.1 Light ballasts in accordance with Ontario Regulation 347.

3.2 Welding and Cutting

3.2.1 All welding and cutting within the existing works is to follow National Fire Protection Association (NFPA) Standard 51B "Fire Prevention in the Use of Cutting and Welding Processes"

3.3 Work In Confined Spaces

3.3.1 Make all Contractor staff including subcontractors aware of confined spaces and the requirements for entering such spaces.

3.3.2 Where work is to be done in confined space conditions, follow the requirements listed in Paragraph 3.4, below.

3.4 Work Procedures for Confined Spaces

3.4.1 All construction activities in confined spaces require entry procedures in accordance with Occupational Health and Safety Regulation 213/91 Sections 60 to 63 inclusive.

3.4.2 Surveillance: Provide a trained person to maintain continuous surveillance of work in confined spaces. This person is not permitted to assist in construction activities or gas monitoring as this person's function is to maintain constant surveillance and initiate rescue procedures should an emergency arise. If work in two or more different confined spaced locations is required at the same time, provide additional trained persons for continuous surveillance per location at no additional cost.

3.5 Holes in Existing Concrete

3.5.1 When it is required to make new holes in existing concrete for piping, conduit, cables, or equipment, using either method described below:

.1 Chip with an electric hammer with chisel point. If any impediment is encountered, advise the Engineer before proceeding further. Adjust the location of holes as necessary to avoid electrical conduits. Cut reinforcing steel after permission is received.

.2 For any openings which are to be saw cut into an existing structure pre-drill the corners using a 100 mm dia. core drill do not over core corners.

.3 Core-drill holes after radiograph procedures are followed.

3.5.2 Radiograph the existing concrete for 3 diameters around the centreline of the proposed penetration. If no structural steel, piping or electrical conduits are found, core the hole. If structural steel, piping or electrical conduits are found, select an alternative location and radiograph it. If structural steel, piping or electrical conduits are found, do not core unless written permission form the Engineer is received.

3.5.3 Prior to commencing work, submit to the Engineer a photocopy of the license issued under the Atomic Energy Control Board Regulations for radiography. Perform work in accordance with current Atomic Energy Control Board Regulations for radiography. Be responsible for boundary controls and signs that protect the personnel and others from hazards in the radiograph work area. Inform the Engineer in writing 48 hours prior to commencing any radiography.

3.6 Protection of, and Modification to Existing Work

3.6.1 All existing structures, mechanical and electrical systems to remain shall be protected in a manner satisfactory to the Engineer. The Contractor shall document existing conditions prior to completing any new works.

3.6.2 Should any parts of the existing structures or systems become heaved, cracked or otherwise damaged after commencement of the work by the Contractor, all such damaged portions of the work shall be completely repaired and made good by the Contractor at its own expense and to the satisfaction of the Engineer, notify the Engineer of any conditions that would not permit the required repairs to be affected. If, in the final inspection of the work any defects, faults or omission are found, the Contractor shall cause the same to be repaired or removed and replaced by proper material and workmanship without extra compensation for the labour and materials required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein for at least the guarantee period described in the General Conditions of the Contract.

END OF SECTION

1 GENERAL

1.1 General

1.1.1 After Contract Award, the Contractor may submit an alternate material or piece of equipment to the Engineer and Owner for review. An Alternate will only be evaluated and considered acceptable if it meets the intent of the original design and specifications, and where there is a credit or no additional cost to the Owner.

1.1.2 The Specification Sections contain pertinent performance criteria, quality, function and requirements for materials and methods to achieve work described.

1.1.3 Co-ordinate pertinent related work and modify surrounding work as required to complete project under each substitute designated at no additional cost to Owner.

1.2 Requests for Substitution

1.2.1 Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier or manufacturer, the naming of the item is regarded as the standard to establish the type, function and quality required.

1.2.2 Material or equipment of equal or better performance and quality may be offered in substitution for those specified. Requests for review of substitute items of material and equipment will not be accepted by the Engineer from anyone other than the Contractor.

1.2.3 All requests for substitution must be accompanied by a detailed listing of the expected cost savings to the Owner.

1.2.4 Substitutions will not be considered when they are indicated or implied on Shop Drawings or product data submittals without a separate written request.

1.2.5 Requests for substitution include any request for changes from the Contractor that require significant design changes, redesign or significant design reviews.

1.2.6 A request for substitution constitutes a representation that the Contractor:

.1 Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.

.2 Will provide the same warranty for the substitution as for the specified product.

.3 Will coordinate the installation and make changes to other Work which may be required for the Work to be complete at the Contractor’s expense and at no additional cost to the Owner.

.4 Waives claims for additional costs or time extension which may subsequently become apparent.

.5 Will reimburse the Owner for review or redesign services.

1.2.7 Request for substitution to be made by written application to the Engineer and is to include sufficient data to enable the Engineer to assess the acceptability of requirements, including the following:

.1 All submittal information required for the specified equipment, including all deviations from the specified requirements and/or necessitated by the requested substitution.

.2 Materials of construction, including material specifications and references.

.3 Dimensional drawings, showing required access and clearances, including any changes to the work required to accommodate the proposed substitution.

.4 Drawings and details showing changes if the offered substitution necessitates changes to or coordination with other portions of the Work. Perform these changes as part of the substitution of material or equipment at no additional cost.

.5 Certification that the proposed substitute will adequately perform the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified with the same or better warranty.

.6 Information and performance characteristics for all system components and ancillary devices to be furnished as part of the proposed substitution.

.7 Certification that acceptance of the proposed substitute will not prejudice achievement of Substantial Performance.

.8 Itemization of all costs including any licenses fee or royalty that will result directly or indirectly from the acceptance of the proposed substitution. Include redesign and cost of claims of any other contract affected by the resulting change.

.9 Guaranteed credit or cost reduction offered if the proposed substitution is accepted and a waiver of claims for additional expenses which may subsequently become apparent.

.10 Recommended maintenance requirements and availability of spare parts and service.

.11 Written confirmation from subcontractors and suppliers on cost, schedule, and technical requirements if requested by the Engineer.

1.3 Engineer's Review

1.3.1 Engineer will evaluate each proposed substitution. Engineer will be the sole judge of acceptability, and no substitute will be ordered, installed or utilized without the Engineer's prior written acceptance by either a Change Order or a reviewed shop drawing. The burden of proof is on the Contractor.

1.3.2 Pay the Engineer's cost for evaluating the requested substitution even though the request may be denied, or for additional redesign work required as a result of any substitution. Costs will be charged on a time and expense basis and will be deducted from progress payments due the Contractor.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section describes the minimum administrative requirements expected by the Contractor to coordinate the work, under the administration of the Engineer.

1.1.2 Involves coordination of project schedules, submittals, meetings, use of site, temporary utilities, construction facilities, construction progress of the work, required shut-downs and commissioning.

1.2 Responsibilities of Engineer

1.2.1 Schedule and administer pre-construction and construction progress (site) meetings, as well as responses to requests for information (RFIs), and clarification of the scope of work.

1.2.2 Prepare the agenda with copies for all participants, and preside at the meeting.

1.2.3 Record minutes and distribute copies of minutes within five working days after each meeting and transmit to meeting participants, affected parties not in attendance, the Contractor and the Owner. The Engineer will include and identify significant proceedings, decisions or actions with ‘Action By’ in the minutes.

1.3 Responsibilities of Contractor

1.3.1 Provide physical space for meetings.

1.3.2 Comply with Engineer's allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities in accordance with Section 01510 – Temporary Utilities and 01520 – Construction Facilities.

1.3.3 Provide information required to the Engineer and be prepared to discuss all items on the agenda, such as schedule updates, two-week look-ahead schedules, responses to previous or outstanding action items.

1.3.4 Representatives of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of the party each represents.

1.3.5 Identify any errors in minutes to the Engineer in writing within three days of receipt. Any conflicts shall be coordinated with the Engineer. Otherwise, it will be interpreted that the Contractor resolves the interference issues at his own responsibility.

1.3.6 During construction coordinate use of site and facilities through Engineer's procedures for intraproject communications, submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

1.4 Pre-construction Kick-off Meeting

1.4.1 Within 15 days from award of the Contract, the Engineer will convene a pre-construction meeting to discuss and resolve administrative procedures and responsibilities from the start of the project.

1.4.2 Representatives of the Owner, the Engineer and the Contractor and major Sub-Contractors shall be in attendance.

1.4.3 The Engineer will establish a time and location for the meeting and notify concerned parties a minimum of five working days before the meeting.

1.4.4 The meeting agenda will include such items for discussions as:

.1 Appointment of official representative of participants in Work.

.2 Schedule of Work, progress scheduling and delivery schedule of major equipment in accordance with Section 01320 –CMP Construction Schedule.

.3 Schedule of submission of shop drawings, samples and colour chips in accordance with Section 01330 – Submittal Procedures.

.4 Requirements and location for temporary facilities, site sign, offices, storage sheds, utilities, and fences in accordance with Section 01510 – Temporary Utilities.

.5 Site security in accordance with Section 01520 – Construction Facilities.

.6 Contemplated changes and change orders procedures, approvals required, mark-up percentages permitted, time extensions and administrative requirements.

.7 Owner supplied products.

.8 Record drawings in accordance with Section 01780 – Closeout Submittals.

.9 Maintenance materials and manuals in accordance with Section 01780 – Closeout Submittals.

.10 Take-over procedures, acceptance and warranties in accordance with Section 01760 – Warranty Work and 01780 - Closeout Submittals.

.11 Monthly progress claims, administrative procedures, progress photographs and holdbacks.

.12 Appointment of independent inspection and testing agencies or firms (i.e., concrete, geotechnical, compaction, asphalt, etc.).

.13 Insurance.

.14 Safety issues.

.15 Environmental issues, including spills reporting.

.16 Other items of discussion

1.4.5 The Engineer will document the responsibilities and necessary activities of the participants during construction as discussed.

1.5 On-Site Documents

1.5.1 Maintain at job site, one copy each of the following:

.1 Contract drawings.

.2 Specifications.

.3 Addenda.

.4 Reviewed shop drawings.

.5 Contract Change Directives.

.6 Other modifications to Contract.

.7 Field test reports.

.8 Copy of approved Work schedule.

.9 Manufacturers' installation and application instructions.

.10 Notice of Project

.11 Building Permit

.12 Health and Safety Plan and related documents

1.5.2 The Owner will supply electronic copies of drawings and specifications in digital format to the Contractor. The Contractor shall reproduce additional copies for his use, if required.

1.6 Schedule Management

1.6.1 Submit to the Engineer within five working days of award of the Contract, the preliminary construction progress schedule, based on the tender, and all required schedules, in accordance with Section 01320 - CPM Construction Schedule.

1.6.2 After review by the Engineer, revise and resubmit all schedules to comply with revised project schedule.

1.6.3 Identify and track all critical items on all schedules and advise the Engineer of any changes to the schedules.

1.6.4 Actively manage and coordinate the work to avoid delays against reviewed schedules.

1.6.5 Revise schedules, reorganize and replace construction to minimize the impact of any identified delays.

1.7 Coordination of Construction

1.7.1 This is a lump sum contract to be completed in its entirety by the Contractor using the Contractor’s own forces or the forces of individual subcontractors and sub-trades.

1.7.2 All of the specifications and drawings shall be interpreted as one Contract and the Contractor shall be wholly responsible for coordination of all work by the Contractor's own forces, sub-trades or subcontractors to complete the work.

1.7.3 No Section or Division of these specifications shall be construed or interpreted as being the responsibility of any sub-trade, subcontractor or supplier.

1.7.4 The Contract Drawings provide general routing of piping and general location of equipment unless specific dimensions are indicated. Locate piping and equipment to avoid interference with walkways, other equipment and required headroom.

1.7.5 The Engineer may furnish supplementary drawings to assist in proper execution of the Works. Such drawings will be issued for clarification only and will have the same meaning and intent as if part of the plans referred to in the Contract Documents.

1.7.6 The Contractor shall examine the work of all trades and ensure that conditions are satisfactory for the completion of any subsequent work.

1.7.7 The Contractor shall notify the Engineer immediately of any adverse conditions which may affect subsequent work and shall not proceed with any subsequent work until such conditions are rectified.

1.8 Submittals

1.8.1 Make all necessary submittals to the Engineer for review and approval.

1.8.2 Submit preliminary shop drawings, product data and samples in accordance with Section 01330 – Submittal Procedures for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to the work of other contracts. After review, revise and resubmit by transmittal to the Engineer.

1.8.3 Submit all requests for payment to the Engineer.

1.8.4 Submit requests for interpretation of Contract Documents, requests for information or clarification of the scope of work to the Engineer.

1.8.5 Submit requests for use of Alternatives to the Engineer.

1.8.6 Submit requests for Contemplated Contract Changes to the Engineer.

1.8.7 Deliver all closeout submittals to the Engineer.

1.9 Construction Progress or Site Meetings

1.9.1 Site meeting frequency shall be bi-weekly, or more frequently as required, at no additional cost to the Contract, if performance and schedule are not to the satisfaction of the Engineer and the Owner, or for additional coordination as required.

1.9.2 The Owner, Engineer and Contractor will be in attendance. The purpose of these meetings is to discuss the progress of the Work and related matters including:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems and conflicts.

.4 Problems which may impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revisions to construction schedule.

.8 Progress, schedule, during succeeding work period.

.9 Review submittal schedules (shop drawing, RFI, etc.): expedite as required.

.10 Maintenance of quality standards.

.11 Pending changes and substitutions.

.12 Review proposed changes for effect on construction schedule and on completion date.

.13 Safety issues.

.14 Environmental issues.

.15 Other business.

1.10 Pre-Commissioning Meeting(s)

1.10.1 A pre-commissioning meeting shall be held 10 working days prior to any commissioning activities to review the pre-commissioning and final commissioning plan and schedule. Where work requires staggered commissioning of unit processes, hold a dedicated pre-commissioning meeting for each unit process.

1.10.2 Attendance at the pre-commissioning meeting shall include the Owner, Engineer, Operator, Contractor-appointed commissioning supervisor, and key Contractor personnel involved with the commissioning of the Work.

1.11 Contractor’s Representative at Meetings

1.11.1 The Contractor shall attend all Construction Progress Meetings or other such coordination meetings as directed by the Engineer.

1.11.2 The Contractor's representative at these meetings shall be the Site Supervisor or Project Manager/Contract Administrator and/or a competent and reliable person who is familiar with the Work. The Contractor's representative shall have full authority to make decisions on the Contractor's behalf.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section specifies requirements and procedures for preparing and updating construction schedules and reports for planning, coordinating, executing and monitoring the progress of the work. The construction work shall be scheduled using the Critical Path Method (CPM) of network analysis.

1.2 Schedules

1.2.1 Prepare schedules in the form of critical path method as described herein.

1.2.2 Provide separate CPM networks (subnetworks) of activities for each process/facility/area of the Works.

1.2.3 Each subnetwork shall be assigned a code and separate activity numbering series.

1.2.4 Interrelationship between subnetworks and any individual activities shall be identified.

1.3 Scheduling

1.3.1 The Critical Path Method type construction schedule will be used to monitor job progress. The Contractor will be responsible for providing all information concerning sequencing, logic and duration of all activities as well as providing the initial CPM logic network diagram and tabular report data. Once the initial logic network diagram is accepted, the contractor will be responsible for providing regular schedule updates including information on logic, percent complete, actual start and finish dates and duration changes.

1.3.2 From the Contractor's initial schedule submittal and from information received at the regular Schedule Update Meetings, computerized and dated tabular schedule reports, updated network diagram and bar charts will be produced by the Contractor and reviewed for accuracy and integrity. It shall at all times remain the Contractor's responsibility to schedule and direct his forces in a manner which will allow for the completion of the work within the contractual duration.

1.3.3 It should be clearly understood that the initial schedule and all updated information must be provided by the Contractor and that this information is a representation of the best efforts of the Contractor and his subcontractors as to how they envision the work to be accomplished. Similarly, all progress information to be provided by and through the Contractor must be an accurate representation of his or his subcontractors' or suppliers' actual performance. The schedule shall at all times remain an accurate reflection of the Contractor's actual or projected sequencing of work. Once accepted, adherence to the established CPM schedule shall be obligatory upon the Contractor and his subcontractors for the work under this Contract. The Engineer may require the Contractor to revise the schedule if, in his judgment, the schedule does not accurately reflect the actual execution of the work or is in violation of any provision on the CPM scheduling specification, and the Contractor shall revise the schedule as often as is necessary during the course of performance of the work without additional cost to the Owner.

1.4 Progress of the Work

1.4.1 The work shall be started on the date indicated in the written order for commencement of the works and shall be executed with such progress as may be required to prevent delay to other Contractors or to the general completion of such parts of the project, and with such forces, material and equipment, as to assure completion of the work in the time established in the Form of Tender. Additionally, the Contractor shall, at all times, schedule and direct his work so that it provides an orderly progression of the work to completion within the specified time for completion.

1.4.2 The Contractor agrees that whenever it becomes apparent from the current regular CPM schedule update that delays to the critical path have resulted and these delays are through no fault of the Owner or Owner's representatives, and hence, that the Contract completion date will not be met, or when so directed by the Owner, he will take whatever action is necessary to achieve the specified milestone and contract completion dates.

1.4.3 With each schedule update, the Contractor shall submit for review a written statement of the steps he intends to take, to remove or arrest any delay to the schedule. If the Contractor fails to submit a written statement of the steps he intends to take or fails to take such steps as required by the Contract, the Owner may direct the level of effort in manpower (trades), equipment and work schedule overtime to remove or arrest the delay to the critical path in the accepted schedule, and the Contractor shall promptly provide such level of effort at no additional cost to the Owner. In addition, should schedule delays persist, the Contractor's bonding agent may be asked to attend meetings to update the schedule.

1.4.4 Failure of the Contractor to comply with the requirements of this provision shall subject him to, at the Owner's Sole discretion, a withholding, in partial or in total of payments otherwise due to the Contractor for work performed under this Contract. The Contractor agrees that any withholding of money is not a penalty for noncompliance, but is an assurance for the Owner that funds will be available to implement these requirements should the Contractor fail to do so, since failure of the Contractor to comply with these requirements shall mean that the Contractor failed to execute the work with such diligence as to ensure its completion within the time for completion.

2 CPM CONSTRUCTION SCHEDULE

2.1 Network Requirements

2.1.1 The network diagram shall show the order and interdependence of activities and the sequence in which the work is to be accomplished as planned by the Contractor. The basic concept of the network analysis diagram is to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of succeeding activities. A time scaled precedence format will be followed. The detailed network diagram will be time scaled showing a continuous flow from left to right.

2.1.2 The scheduled activities shall be developed into four major groups:

.1 Mobilization

.2 Procurement Activities, Shop Drawings Submittals, Review/Approval

.1 Each of the following procurement items should be tied logically to the correct construction activity in the overall CPM construction schedule:

.1 Permits and Approvals

.2 Submittal Items

.3 Approval of Submittal Items

.4 Fabrication and Delivery of Submittal Items

.2 Construction Activities

.1 Construction activities are the physical work activities that describe how the job will be constructed.

.3 Shutdowns and Tie Ins

.1 Work by Owner

.2 Work by Contractor

.4 Testing, Training, Start-up and Closeout

.1 CPM activities for this group shall include all work required to satisfy the appropriate specification sections and meet the requirements of substantial performance and contract completion.

2.1.3 The Contractor shall break the work into activities with a duration of minimum 5/maximum 20 (5-20) working days each, except for non-construction activities (such as procurement of materials and delivery of equipment) and other activities which may require a longer duration and shutdowns, tie-ins and connections, which may require a shorter duration. To the extent feasible, activities related to a specific physical area of the project shall be grouped on the network for ease of understanding and simplification. The selection and number of activities shall be subject to review by the Owner.

2.1.4 Each activity on the network shall have indicated for it the following:

.1 A single duration (5<duration<20) (i.e., the single best estimate of the expected elapsed time considering the scope of work involved in the activity) expressed in working days. Normal holidays and inclement weather shall be allowed for. One critical path shall be identified for the schedule.

.2 An activity I.D. number will be assigned to each activity. The I.D. number shall be numeric only with a maximum of five (5) digits, or as agreed with the Engineer.

.3 A brief description of the activity will be included. If the description is not definitive, a separate listing of each activity and a descriptive narrative may be required.

.4 Each activity (except for procurement activities) shall be cost loaded to indicate the total estimated cost of the activity. No activity should exceed $60,000, except in the case of an equipment supply item, or as agreed with the Engineer.

.5 Each activity shall be man-hour loaded with the estimated man-hours to be expended on each activity.

.6 The schedule calendar should be a 5-day work week with holidays corresponding to those observed by the Owner.

2.1.5 Failure to include on a network any element of work required for the performance of this Contract shall not excuse the Contractor from completing all the work required within the applicable completion time, notwithstanding the Owner's network review.

2.1.6 A CPM schedule which shows the completion of any milestone or substantial performance prior to the contractual completion dates stipulated may be accepted by the Engineer but shall in no event form the basis of a claim for delay against the Owner by the Contractor.

2.1.7 The Contractor will be required to submit to the Engineer, the original CPM schedules on Microsoft Project. The schedule shall be submitted in original version electronic format and hardcopy. This requirement is in addition to the required reports and network diagrams specified previously.

2.2 Schedule of Values

2.2.1 Each activity on the construction schedule shall be allocated a dollar value in accordance with Part 'B' of the Form of Tender (Detailed Total Contract Price Breakdown). Each activity's assigned cost shall consist of labour, equipment, and materials costs, and a pro rata contribution to overhead and profit. The sum of all activity costs shall be equal to the total contract price. In submitting cost data the Contractor certifies that they are not unbalanced and that the values assigned to each activity represents the Contractor's estimate of the actual costs of performing that activity. The listing of cost loaded CPM activities will become the schedule of values and will serve as a basis for progress payments to the contractor.

2.2.2 The accepted schedule of values shall represent a fair, reasonable and equitable dollar cost allocation for each activity on the Contractor's construction schedule.

2.2.3 If it is determined that the cost data do not meet the requirements for a balanced bid breakdown, the Contractor will present documentation substantiating any cost allocation on the cost data. Cost allocations shall be considered unbalanced if any activity on the construction schedule has been assigned a disproportionate allocation of direct cost, overhead and profit.

3 SCHEDULE SUBMITTALS

3.1 CPM Schedule Implementation

3.1.1 Within twenty (20) working days after Notice to Proceed, the Contractor shall submit the CPM Construction Schedule for the entire contract duration and shall include all activities listed in Clause 2.1.2 of this section. All reports shall be sorted by total float and activity number and shall include a predecessor/successor listing, resource loading reports and project calendar. The logic diagram shall be drawn as described herein and will be the subject of a schedule review meeting with the Contractor, the Owner and the Engineer within two (2) weeks of its submission. If a review of the submitted CPM schedule indicated a work plan which will not complete the work within the time requirements stated in the Contract, it shall be the responsibility of the Contractor to revise the CPM schedule as required and resubmit it until it is acceptable. Failure by the Contractor to submit an acceptable schedule may, at the Owner's sole discretion, be sufficient cause for the withholding of any portion of any payment(s) otherwise due under the contract.

3.1.2 Acceptance of the schedule shall not constitute a representation by the Owner that the work can be completed as shown on the schedule.

3.2 Schedule Updates

3.2.1 A regular Schedule Update Meeting will be held one (1) week prior to every other construction progress meeting at the construction site to review actual progress and update the CPM schedule as necessary. The schedule Update meeting will be attended by the Contractor, the Owner and the Engineer. Actual progress of the previous month will be recorded and future activities will be reviewed. The duration of activities and their logic connections may be revised as needed. Decisions made at these meetings and agreed to by all parties are binding with the exception that no contractual completion dates will be modified without formal written requests by the Contractor and acceptance by the Engineer as specified herein. The Contractor must provide the following information for each update at a minimum:

.1 Actual start and finish dates for all completed activities.

.2 Actual start dates for all started but incomplete activities including remaining durations.

.3 All required schedule revisions to reflect actual progress to date as well as projected sequence of remaining schedule activities.

.4 Update all activity cost accounts and activity resources as to current period, total to date, and projected at completion.

.5 A cash flow diagram showing by month the actual work performed to date and the predicted progress to the end of the project. The amounts will be the total pre-tax and will include contingency funds as expenditures only as they become known.

3.3 Look-Ahead Schedule

3.3.1 Provide by 4:00 pm EST on the first work day of each week a Weekly Progress and Planning Report including the following:

.1 An overview of the previous working week's progress including quantification where applicable.

.2 An updated schedule showing progress to date, critical path, and planned activities for the upcoming four weeks (on a rolling basis). All major upcoming items are to be highlighted, especially where coordination is required (e.g., shutdowns, inspections).

.3 General summary of staff utilization including downtimes for training, maintenance of equipment, waiting on others (such as Engineer, Owner or others), etc.

.4 Summary log of all Issues/Concerns, RFIs, RFCs, and current status.

.5 Health and Safety summary including the names of all those who have received the Contractor's and the site-specific training and any incident reports.

.6 Summary of all external visitors to site including the Owner, the Engineer, regulatory authorities, the testing companies, the subcontractors and the suppliers.

4 CONTRACT COMPLETION TIME

4.1 Causes for Extension of Time

4.1.1 The contract completion time will be adjusted only for causes specified in the contract. In the event the Contractor requests an extension of any contract completion date, he shall furnish justification and supporting evidence. The Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If the Engineer finds that the Contractor is entitled to an extension of the Contract completion date under the provisions of the contract, the Engineer's determination as to the total number of days' extension shall be based upon the current accepted and updated CPM schedule and on all data relevant to the extension. Such data shall be included in the next monthly updating of the schedule. The Contractor acknowledges and agrees that actual delays in activities which, according to the CPM schedule, do not affect any contract completion date shown by the critical path in the network do not have any effect on the contract completion date or dates and therefore will not be the basis for a change in Contract completion time.

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 Shop drawings and product data.

1.1.2 Samples.

1.1.3 Record drawings.

1.1.4 Certificates and transcripts.

1.2 Administrative

1.2.1 Submit all listed submittals to the Engineer for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Works. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

1.2.2 Work affected by submittals shall not proceed until the review and approval process is complete.

1.2.3 Present shop drawings, product data, samples and mock ups in SI Metric units.

1.2.4 Where items or information is not originally produced in SI Metric units, converted values are acceptable.

1.2.5 Review submittals prior to submission to the Engineer. This review confirms that each submittal has been checked and coordinated with requirements of the Works and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.

1.2.6 Notify the Engineer in writing, at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations. Also refer to Section 01200 – Alternatives.

1.2.7 Verify that field measurements and affected adjacent work have been coordinated.

1.2.8 The Contractor’s responsibility for errors and omissions in submittals is not relieved by the Engineer's review of submittals. The review of shop drawings by the Engineer is for the sole purpose of ascertaining conformance with the general design concept on the Contract Drawings and documents. This review shall not mean that the Engineer approves detail design inherent in the manufacture of specific pieces of equipment, or those details required for construction, the responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and the Contract Documents. Without restricting the generality of the foregoing, the Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the work of all sub trades.

1.2.9 The Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by the Engineer's review.

1.2.10 The Engineer has allowed for up to two shop drawing submittals and reviews as part of the normal approval process. Any more than two shop drawing submittals will be considered a deviation for which the Engineer may seek compensation from the Contractor for the additional time and effort of shop drawing review. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

1.2.11 Keep one reviewed copy of each submission on site.

1.3 Shop Drawings and Product Data

1.3.1 Refer to the specified named acceptable products as appropriate.

1.3.2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Works.

1.3.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Works. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of where they are specified or on which drawings the work appears. Indicate cross-references to Contract Drawings and Specifications.

1.3.4 Identify all shop drawings as agreed with the Engineer.

1.3.5 Allow 10 working days for the Engineer's review of each submission.

1.3.6 Adjustments made on shop drawings by the Engineer do not address the issue of Contract Price. If adjustments affect the value of the Works, state this in writing to the Engineer prior to proceeding with the work.

1.3.7 Make all changes to shop drawings as required by the Engineer and consistent with Contract Documents. When resubmitting, notify the Engineer in writing of any revisions other than those requested.

1.3.8 Submittals:

.1 Submittals may either be uploaded to the CIMA FTP (file transfer protocol) site and transmitted to the Engineer with a Submittal Transmittal Form in a form acceptable to Engineer for official submission, emailed with a Transmittal Form or submitted in hardcopy.

.2 The marked-up copies will be returned to the Contractor either via the CIMA FTP site, email or hardcopy by mail/courier.

.3 The final submittals will be retained by the Engineer and stored at the site office.

.4 The Contractor is responsible for producing hardcopies and sharing softcopies with Equipment Manufacturers and with subcontractors.

.5 Submittal Cover Page

.1 For each discrete submittal, type or print the appropriate information on a cover page to fully describe the submittals being sent for review. Include the cover page for each discrete submittal. The title page shall include the following:

.1 Project Title

.2 Project / Contract Number

.3 Submittal / Shop Drawing Title

.4 Contractor Reference Number (if applicable)

.5 Specification and Clause reference

.6 Revision Number

.7 Filename

1.3.9 Submissions shall include:

.1 Contractor's name, contact phone no. and address.

.2 Date and revision dates.

.3 Project title and number.

.4 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Section of Contract where specified and location to be installed.

.6 Apply shop drawing stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.7 Details of appropriate portions of Work as applicable:

.1 Fabrication.

.2 Layout, showing dimensions, including identified field dimensions and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating Weight.

.8 Complete piping drawings, including size and location of all sleeves and/or openings to be formed into structural works.

.9 Submit all equipment and instrument shop drawings in advance of MCC and control panel shop drawings to allow coordination and any vendor specific power, I/O or control wiring requirements.

.10 Wiring diagrams.

.11 Single line and schematic diagrams.

.12 Relationship to adjacent work.

.13 Enclosure ratings (NEMA or IEC) for electrical equipment

.14 Electrical supply requirements including:

.1 Acceptable voltage range for mains and control power

.2 Current draw at full load

.3 Maximum and/or minimum setting of upstream protection

.4 Withstand and interrupt ratings

1.3.10 Submit one copy of product data sheets or brochures for requirements requested in the specifications and as requested by the Engineer where shop drawings will not be prepared due to standardized manufacture of product.

1.3.11 Submit shop drawings for each requirement requested in specification Sections and as the Engineer may reasonably request.

1.3.12 Softcopy submittals

.1 All softcopy submittals shall be named using the following nomenclature: [5]-[3]-R[2]-[4]-[1].pdf, where the fields in the filename are defined as follows:

.1 [1] = Contractor specific unique reference number (if applicable)

.2 [2] = Revision number

.3 [3] = Specification and clause number

.4 [4] = Submittal/Shop Drawing title

.5 [5] = Project/Contract number

.2 Each discrete shop drawing submittal shall be a single complete PDF document complete with cover page as the first page.

.3 At the request of the engineer, the Contractor shall submit native files of certain submittals (MS Word, MS Excel, MS Project, Primavera, etc.) to help expedite the review process.

1.3.13 Submittals will be returned with one or of the following notations. Take action as noted:

.1 "REVIEWED WITH NO COMMENT" - Make and distribute additional copies promptly as required for execution of Work. Instruct parties to report promptly any inability to comply with provisions.

.2 "REVISE & RESUBMIT" - Make the necessary revisions and resubmit revised drawings for review. This procedure will not relieve the responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of Contract. Show the drawing number of the first such revised drawing and show the latest revision number applicable to the drawing by increasing the revision index – “R0”, “R1”, “R2”, etc. Refer to 01330 – Submittals – Supplement B: Submittal file naming Convention Instructions for instructions on how to apply revision numbers.

.3 “REVIEWED AS NOTED” – Make the necessary revisions prior to commencing with the execution of work. A resubmission for Engineer review is not required. Resubmit with all necessary revisions for record purposes.

.4 “REJECTED” – This notation indicates that the Engineer has received the submission and has deemed it incomplete or improper for review.

.5 "NOT REVIEWED" - This notation indicates when Engineer has acknowledged receipt of the shop drawing and that a review is not required.

1.3.14 Use only those shop drawings on the work that bear the "NO COMMENT" or “AS NOTED” notation.

1.3.15 Do not revise shop drawings marked "NO COMMENT" unless resubmitted to the Engineer for further review.

1.3.16 Ship one set of approved shop drawings, installation instructions, lubrication schedules, parts lists and other information along with each piece of equipment to the Site and clearly mark "DO NOT REMOVE FROM SITE".

1.3.17 Neither the Engineer nor the Owner will accept responsibility for the cost of changes necessary if any equipment is fabricated without prior review of shop drawings. Completion of the Engineer’s review will be designated by the presence of his initialed reviewed stamp on the returned drawings.

1.3.18 Where more than one type of shop drawing has been specified for one item, e.g., wiring diagrams, layout details, and dimensional drawings, the shop drawings will be submitted together, to enable Engineer to review the drawings as a package.

1.3.19 Catalogue pages or drawings applicable to an entire family or range of equipment will not be accepted as shop drawings unless they are clearly marked to show the pertinent data for the particular materials.

1.3.20 Manufacturers' catalogues, manuals, or price lists will not be accepted as shop drawings. Such materials may be used as supplemental information to the shop drawings.

1.3.21 Indicate the tag number of all instruments and valves and clearly show the features and details applicable to the equipment being supplied.

1.3.22 Determine which shop drawings have, in addition to those drawings specifically mentioned in the Contract, design elements requiring the seal of a Professional Engineer registered in the Province of Ontario, in accordance with the applicable provincial or federal engineering acts or other governing legislation. Seal such drawings before submitting them for review. Submit for review engineering calculations signed by the registered Professional Engineer responsible for the shop drawing design elements.

1.3.23 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, a copy will be returned denoted “Reviewed with Comments”, and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned denoted “Revise and Resubmit”, and resubmission of corrected shop drawings, through the same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.3.24 The Owner may deduct, from payments due, costs of additional engineering design or review incurred if the Contractor does not submit correct shop drawings after two reviews.

1.3.25 The review of shop drawings by the Engineer is for sole purpose of ascertaining conformance with general concept. This review shall not mean that the Engineer approves detail design inherent in shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and the Contract Documents. Without restricting the generality of the foregoing, the Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub trades.

1.3.26 As per Item 1.5, prepare and submit proposed sleeve location drawings showing the location and size of sleeves, openings and miscellaneous items to be formed in the work with the reinforcing steel drawings to allow full coordination. Any reinforcing steel modifications required as a result of failure of the Contractor to provide these drawings, will be at no cost to the Owner.

1.3.27 Submit all equipment and instrument shop drawings in advance of MCC and control panel shop drawings to allow coordination and any vendor specific power, I/O or control wiring requirements.

1.3.28 Delete information not applicable to project from all submittals.

1.3.29 Supplement standard information to provide details applicable to project as required.

1.3.30 When corrected copies are resubmitted, the Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by the Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals.

1.3.31 When resubmittals are needed, resubmittals shall be made within 10 business days. The Contractor may submit an acceptable request for an extension of time, listing the reasons why the resubmittal cannot be completed within the stipulated time.

1.3.32 The need for more than two resubmittals, or any other delay in obtaining the Engineer review of submittals, will not entitle the Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order.

1.3.33 The maximum size of shop drawings shall be 600mm x 900mm to permit red line photocopy reproduction. Digital pdf copies of all drawings shall be printable such that the scale can be checked.

1.3.34 Shop drawings which require the approval of a legally constituted authority having jurisdiction shall be submitted by Contractor to such authority for approval. Such shop drawings shall receive final approval of authority having jurisdiction before Consultant's final review.

1.3.35 Drawings stamped “As Noted” must be revised for inclusion in the Operation and Maintenance Manuals.

1.3.36 Submit hardcopy and softcopy sets of final shop drawings as part of the Operation and Maintenance submission.

1.4 Samples

1.4.1 Submit samples in duplicate for review as requested in respective specification Sections. Submit samples with identifying labels bearing material or component description, manufacturer’s name and brand name, Contractor’s name, project name, location in which material or component is to be used, and date.

1.4.2 Deliver samples prepaid to the Engineer's business address, or as otherwise directed by the Engineer.

1.4.3 Notify the Engineer in writing, at time of submission of deviations in samples from requirements of the Contract Documents.

1.4.4 Where colour, pattern or texture is a selection criterion, submit the full range of samples.

1.4.5 Adjustments made on samples by the Engineer do not address the issue of Contract Price. If adjustments affect the value of the Works, state such in writing to the Engineer prior to proceeding with the work.

1.4.6 Make all changes to samples as required by the Engineer and consistent with Contract Documents.

1.4.7 Reviewed and accepted samples will become the standard of workmanship and material against which installed work will be verified.

1.5 Insert and Sleeve Location Drawings

1.5.1 Submit insert and sleeve location drawings showing the location and size of sleeves, anchor bolts, openings and miscellaneous items to be formed in the work. Submit these drawings with the reinforcing steel drawings to allow full coordination.

1.6 Site Progress Records

1.6.1 All site progress reports shall be provided as required to the Engineer and a copy shall also be kept for the Contractor's records.

1.6.2 Provide by 10:00 am EST a Daily Progress Report including the following:

.1 The weather conditions with maximum and minimum temperatures

.2 The conditions encountered during excavation

.3 The commencement and the completion dates of the work of each trade in each area of the Contract.

.4 The erection and removal dates of formwork in each area of the Contract

.5 The dates, the quantities, and the particulars of each concrete pour

.6 The dates, the quantities, and the particulars of roofing installation

.7 The dates on which major items are installed.

.8 The numbers and classifications of the Contractor's and the Sub-contractor's trades people working at the site and the numbers and classifications of construction machinery and equipment and the number of hours each is operated.

.9 The visits to the site by the Owner, Engineer, the Regulatory Authorities, testing companies, the Sub-contractors and the suppliers.

1.7 Preconstruction and Progress Photographs

1.7.1 Provide preconstruction photographs in digital format, prior to commencement of work on the site. Deliver to the Owner/Engineer before starting any construction, two electronic copies by digital devices. The Owner/Engineer may direct the Contractor to obtain additional photographic records of structures and features within the site limits. The pre-construction records will be compared to the post-construction records to assess damage or displacement of existing structures.

1.7.2 Obtain pre-construction photos of the existing:

.1 Roads, sidewalks and curbs.

.2 Shoulder and grass areas.

.3 Building exterior.

.4 Interior views of rooms, tunnels, etc., where modifications are planned.

1.7.3 On commencement of work and at monthly intervals thereafter, provide two copies of six different view photographs to illustrate the progress of the work. Photographs are to be taken by a professional photographer from locations selected by the Engineer. Owner reserves the right to request hard copies of digital pictures as necessary, printed on photo quality media.

1.7.4 Photographs must be clearly identified with project name, date and location of exposure.

1.7.5 Submit progress photographs with monthly application for payment.

1.8 Operation and Maintenance Data

1.8.1 Submit per Section 01780 – Closeout Submittals.

1.9 Record Drawings

1.9.1 Submit per Section 01780 – Closeout Submittals.

1.10 Equipment and Systems

1.10.1 Submit per Section 01780 – Closeout Submittals.

1.11 Spare Parts

1.11.1 Provide spare parts, in quantities specified in individual specification sections.

1.11.2 Provide items of same manufacture and quality as items in Work.

1.11.3 Deliver to site location and place in storage as directed by the Owner.

1.11.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to Substantial Performance.

1.12 Maintenance Materials

1.12.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

1.12.2 Provide items of same manufacture and quality as items in Work.

1.12.3 Deliver to site location and place in storage as directed by the Owner.

1.12.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to Substantial Performance.

1.13 Special Tools

1.13.1 Provide special tools, in quantities specified in individual specification section.

1.13.2 Provide items with tags identifying their associated function and equipment.

1.13.3 Deliver to site location and place in storage as directed by the Owner.

1.13.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to Substantial Performance.

1.14 Warranties and Bonds

1.14.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

1.14.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.14.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers.

1.14.4 No warranty will commence until issuance of Substantial Performance on respective work components. The warranty on items used during construction, with the Owner's permission, for the safe and orderly completion of the works will not commence until Substantial Performance.

1.14.5 Verify that documents are in proper form, contain full information, and are notarized.

1.14.6 Co execute submittals when required.

1.14.7 Retain warranties and bonds until time specified for submittal.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Construction Safety Measures

1.1.1 Contractor shall submit a site-specific Health and Safety Plan within 5 working days after the date of Notice to Proceed or prior to mobilization on site, whichever occurs first. The site-specific Health and Safety Plan must address the requirements of the Acts. As Constructor, the Contractor will be required to prepare a Site-Specific Health and Safety plan to be submitted for review by the Owner. The Contractor is to submit the draft plan at the Pre-Construction Meeting which shall be revised, if needed, before construction begins.

1.1.2 The contractor shall meet the requirements of the following:

.1 Occupational Health and Safety Act, Regulations for construction projects, O.Reg. 213/91 (as amended. by O.Reg. 631/94), Part II General Construction.

.2 Occupational Health and Safety Act, Industrial Establishments Regulation, R.R.O. 1990, Reg. 851 (as amended by O.Reg. 516/92; 630/94; 230/95; and 450/97), Part I Safety Requirements.

.3 Revised Statutes of Ontario 1980, Chapter 321, Revised Regulation of Ontario 1980, Regulation 691 as amended by O.Reg. 156/84 and O.Reg. 645/86, and Ontario Regulation 714/82.

.4 Workers Safety & Insurance Board (WSIB) and municipal statutes and authorities.

1.1.3 In event of conflict between any provisions of above authorities, the most stringent provision governs.

1.1.4 The Contractor is designated “Constructor” as defined by law.

1.2 Special Protection and Precautions

1.2.1 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials and regarding labelling and the provision of material safety data sheets (MSDS) acceptable to Labour Canada.

1.2.2 Conform to the Ministry of Labour requirements for work in hazardous locations. Establish and implement written procedures to assure compliance.

1.2.3 Comply with the Owner’s and Plant Operations Health and Safety Procedures.

1.2.4 Provide site specific health and safety training to all Contractor and Sub-Contractor staff on-site. To ensure all staff on site have attended site orientation and are accounted for in case of emergency, the Contractor is required to provide to the Owner a daily attendance sheet, listing individual’s names.

1.2.5 Submit all required training certificates related to performing the Work to the Owner prior to undertaking the Work, e.g. confined space training, fall arrest training, asbestos awareness training.

1.2.6 Contractor to obtain CAD rating and WSIB clearance certificates from each sub-contractor and to provide to Owner upon request.

1.2.7 Smoking is not permitted in hazardous areas or other areas as designated by the Owner. Post "No Smoking" signs as required.

1.3 Safety and First Aid Facilities

1.3.1 Provide and maintain on Site, in a clean orderly condition, completely equipped First-Aid kit or facilities readily accessible at all times to Contractor's employees and, the Engineer and the Owner.

1.3.2 Facilities and staffing to be in accordance with the Industrial First Aid Regulations of the Workplace Safety and Insurance Board and OSHA regulations.

1.3.3 Provide fire extinguishers, smoke and CO monitors for trailers.

1.3.4 Supply three additional hardhats and safety vests for visitors to site.

1.3.5 Provide and maintain on the site a completely equipped first aid kit, which shall be readily accessible at all times to all employees and the Owner.

1.3.6 Designate certain employees who are properly instructed to be in charge of first aid. At least one such employee is to be always available on the site while work is being carried out.

1.3.7 A telephone call list for summoning aid, such as doctors, ambulances, pulmotors and rescue squads from outside sources is to be conspicuously posted.

1.4 Safety Equipment and Hazardous Areas and Materials

1.4.1 Safety equipment such as gas detection equipment for explosive or toxic gases or oxygen deficiency, safety belts, ropes, etc., are to be made available to the Engineer as necessary for inspection.

1.4.2 Construction personnel requiring use of respiratory equipment are to be clean shaven.

1.4.3 Post warning signs at hazardous areas or where hazardous materials are stored and install protective barriers. Instruct personnel in proper safety procedures. Inform the Owner of the location of these materials. The Contractor shall ensure that these materials are not kept stored or used on site without the Owner's prior consent or approval

1.4.4 Identify all areas considered to be hazardous locations and comply with all requirements of the Ministry of Labour.

1.4.5 Ensure compliance with CGA B149.6-11 and applicable safety codes when working on or in the area of natural and digester gas lines. Purge all gas lines with nitrogen prior to proceeding with work. Note that certain gas lines passing through the work area will continue in service during this construction. Take suitable safety precautions at all times.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 This Section covers the work for the protection of the environment during construction.

1.1.2 The requirements of this Section are in addition to the requirements of any other Section of this specification and are not meant to limit in any way regulations, guidelines, laws or by-laws in effect at time of construction.

1.1.3 In all cases the most stringent requirements for environmental protection shall govern.

1.2 General Provisions

1.2.1 Be responsible for the protection of the natural environment of the site and surrounding areas, both land and water. Protection of the environment must start with avoidance and prevention, and then control/mitigation, compensation, or enhancement (in order of descending preference).

1.2.2 Prime consideration must be given to protecting the environment during all phases of construction. Co-operate fully with the Engineer, Owner, operating personnel and local authorities to protect the natural environment.

1.2.3 Obtain the Engineer's approval of planned work and storage areas and proposed access roads. Submit a written proposal prior to starting construction.

1.2.4 Project construction activities must be carried out in compliance with all applicable environmental laws and regulations.

1.2.5 All materials (hazardous and non-hazardous) shall be handled so as to protect human health and the environment.

1.2.6 Activities shall be planned and implemented, and equipment shall be managed and maintained in a manner that minimizes air emissions.

1.2.7 Prevent the accidental discharge of containments into soils, surface water and/or groundwater. Any accidental contamination shall be reported to the Ministry of Environment immediately and cleaned up as per provincial requirements.

1.2.8 Erosion control measures shall be designed, implemented and maintained to ensure that there is no increased sediment loading to surface waters leaving the Project site. The Contractor is responsible for ensuring that the erosion control measures are implemented and maintained throughout the duration of the Project.

1.3 Inspection

1.3.1 Be advised that inspectors from the Owner, MECP, MOL, Conservation Authority and other authorities having jurisdiction may make periodic visits to the Site during construction. They have the authority to order the Contractor to stop work if in their opinion the Work is not being completed so as to ensure compliance with the environmental objectives. Acceptance of the Work by the Engineer may be withheld until the Owner and other authorities have issued their approval.

1.4 Limits of the Site

1.4.1 The limits of the site working area are shown on the Contract Drawings and described in the specifications. Confine operations within these limits, unless written approval is obtained from the Engineer and from the property owners concerned.

1.4.2 Install snow fencing stakes or other barriers suitable to the Engineer and other authorities to clearly define the working limits of the Site, parking areas, storage areas, maintenance areas and haul routes within the site, and confine activities to these areas. Submit drawings of the Site showing areas outlined above for review by the Engineer.

1.5 Erosion and Sediment Control

1.5.1 Prior to the commencement of any work on this project which might cause erosion and/or sedimentation, the Contractor must receive approval from the Engineer for an erosion and sedimentation control program proposed by the Contractor. This program must be in accordance with Ontario Guidelines on Erosion and Sediment Control for Urban Construction Sites (latest revision).

1.5.2 Ensure adequate environmental protection and take precautions at times of inclement weather (i.e., ensure erosion and sedimentation control measures are functioning effectively and install additional measures as necessary).

1.5.3 All costs for developing and implementing an erosion and sediment control program shall be included in the price tendered.

1.6 Site Drainage and Unwatering Discharge

1.6.1 Direct the discharge of unwatering operations from any site excavation to an adequate sediment basin by pumping unless approved otherwise by the Engineer. The discharge pipe shall be fitted with a "Wetland" filter bag for removal of silt. Filter bags shall be inspected periodically and replaced once full.

1.6.2 Prevent soil and debris carried by site drainage from entering existing sewers; swales or draining on to adjacent property in the vicinity. At areas where discharge of unwatering will, of necessity, flow onto adjacent private property make arrangements with the property owners concerned. Take adequate precautions to prevent damage to adjacent property. Avoid point discharge of unwatering which will cause erosion.

1.6.3 Direct all run-off and overland flow from the site working and stockpiling area to an adequate sediment basin prior to discharge to a watercourse. The sediment basin shall incorporate straw bales, filter berms, sand bags, etc. as required to eliminate silt or debris from entering any watercourse.

1.6.4 Install check dams and silt control fencing in locations as shown on the drawings and other locations, as directed by the Engineer.

1.6.5 The inspection and cleaning as required, of siltation barriers shall be carried out weekly and after each rainfall. During prolonged rainfall, check daily. Clogged filter materials such as crushed stone or straw bales, etc., shall be replaced as required and as directed by the Engineer.

1.6.6 If the erosion and sediment control measures are damaged or fail the Contractor is responsible for rapid and effective response to such events to minimize the introduction of sediments to aquatic systems.

1.7 Noise Control

1.7.1 If machinery, motors, pumps and other similar equipment must be operated beyond the normal working hours, keep the noise below a level acceptable to the Engineer by housing the equipment at no additional cost to the Contract.

1.7.2 Establish and maintain site procedures such that noise levels from construction areas are minimized. Use vehicles and equipment equipped with efficient muffling devices. Provide and use devices that will minimize noise levels in the construction area. Adhere to all local noise bylaws.

1.8 Dust Control

1.8.1 Prevent dust nuisance resulting from construction operations at all locations on site. Provide water for dust control as directed by the Engineer.

1.8.2 Use appropriate covers on trucks hauling fine or dusty material.

1.8.3 Use watertight vehicles to haul wet materials.

1.8.4 Employ only wet type equipment for saw cutting or concrete grinding to control dust nuisance.

1.8.5 All trenches and areas disturbed by construction works that will produce dust shall be maintained dust free by an application of water.

1.8.6 Obtain Engineer's approval before chemicals are used for dust control. Under no circumstances is sodium chloride permitted for dust control.

1.8.7 Do not use calcium chloride on access roads.

1.9 Mud Control

1.9.1 Keep plant and public roadways clean and free from mud.

1.9.2 Provide mud mats and/or wash stations to prevent tracking of mud from any portion of the contract limits onto any paved roadway.

1.9.3 Obtain and pay for the services of clean outside roads into the site with a street sweeper vehicle as required; or as directed by the Engineer. The street sweeper should be capable of wet and dry cleaning. Ensure that dust is controlled during cleaning operations. Mud, dust and other debris from the construction site will not permitted on the main roads leaving the site. The Contractor will be responsible for street cleaning as required for the duration of construction until Substantial Performance.

1.10 Refuelling Areas

1.10.1 Carry out all refuelling, except the fuelling of backhoes and shovels at approved refuelling areas only.

1.10.2 Review in detail proposed route and sequencing of construction to plan access routes and fuelling areas. Establish suitable fuelling and maintenance areas and obtain approval from Engineer.

1.10.3 Do not refuel, clean or maintain equipment adjacent to or in any watercourses or drains leading to watercourses. Do not fuel equipment within 30 metres of any watercourse unless non-spill facilities are used. Emptying of fuel, lubricants, pesticides or construction materials into any watercourse is strictly forbidden.

1.11 Cleaning Equipment

1.11.1 Clean construction equipment prior to entering roadways. Do not clean equipment in locations where debris can gain access to sewers or watercourses.

1.12 Contingency and Emergency Response Plans

1.12.1 To fulfil its commitment to protecting public and worker health and safety, and the environment, the Contractor is required to adopt a preventive strategy. Through this strategy, the potential issues and emergency events that can be anticipated will be identified and procedures put in place to minimize their potential occurrence.

1.12.2 To address unanticipated events, the Contractor is required to develop Contingency and Emergency Response Plans and implement these plans as part of its contract with the Owner for undertaking the Project.

1.13 Spills

1.13.1 Submit procedures for interception, rapid clean up and disposal of spillages that may occur for Engineer's review prior to commencing work. Be prepared at all times to intercept, clean up and dispose of any spillage that may occur. Keep all materials required for clean-up of spillages readily accessible on site.

1.13.2 Report immediately any spills causing damage to environment to:

.1 Spills Action Centre of the Ministry of the Environment, Conservation and Parks Tel. 1 (800) 268-6060 and (416) 325-3000.

.2 The Municipality in which the spill occurred and the operating authority of the supply system water plant.

.3 Any other authority having jurisdiction or an interest in the spill including any Conservation Authority, water supply authorities, drainage authority, road authority, fire department etc.

.4 The Owner of the pollutant, if known.

.5 The person having control over the pollutant if known.

.6 The Engineer.

1.13.3 Contact the manufacturer of the pollutant, if known, and ascertain the hazards involved, precautions required and best measures to be used in any clean up or mitigating action.

1.13.4 Take immediate action using any available resources to contain and mitigate the effects on the environment from any accidental spill.

1.14 Removal and Disposal

1.14.1 Remove surplus materials and temporary facilities and controls from the Site.

1.14.2 Dispose of all non-contaminated waste materials, litter, debris and rubbish off-Site.

1.14.3 Do not burn or bury rubbish and waste materials on the Site.

1.14.4 Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

1.14.5 Do not discharge wastes into streams or waterways.

1.14.6 Dispose of debris including excess construction material, non-contaminated litter and rubbish at an appropriate off-Site facility identified by Contractor and approved by Owner.

1.15 Environmental Awareness Training

1.15.1 The Contractor is responsible for developing and implementing environmental awareness training to ensure that all on-site personnel are aware of environmental sensitivities associated with their actions; their roles and responsibilities in protecting the environment; and the mechanisms available for them to carry out their environmental protection responsibilities. The training program must include specific environmental awareness programs for the Contingency and Emergency Response Plans developed for the project.

1.15.2 The Contractor is responsible for submitting the training program for the Engineer's review and approval. The appropriate changes are to be made based on Engineer's review comments

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Requirements Included

1.1.1 Regulations affecting the Work imposed by the most recent editions of

.1 American Water Works Association

.2 Ontario Building Code

.3 Occupational Health and Safety Act Regulations for Construction projects, covering safety, hazardous materials, Workplace Hazardous Material Information Ontario

.4 Ministry of the Environment, Conservation and Parks (MECP)

.5 Municipal by-laws and servicing standards

.6 Municipal utilities

.7 Ontario Fire Code (OFC)

.8 Boilers & Pressure Vessels Act Ontario (MCCR, TSSA, etc.)

.9 Energy Act Ontario

.10 Ontario Electrical Safety Code (OESC), latest edition and ESA bulletins

.11 Environmental Protection Act, Ontario Regulation 309

.12 Environment – Air, Ontario Regulation 346

.13 Environment – Noise, Ontario Regulation NPC 205

.14 Codes & Standards for National Fire Protection Association (NFPA)

.15 Ontario Reduce, Reuse and Recycle Regulations O.Reg. 101/94-105/94

.16 CSA Certificate Standards and Electrical Bulletins

.17 OSHA Standards for equipment

.18 CSA-2462-08 Safety in Workplace for Arc Flash Hazard

.19 Local Conservation Authority

.20 Municipal by-Laws and Regulations

1.2 Compliance with Regulations

1.2.1 Ascertain requirements and regulations of authorities listed above.

1.2.2 Comply with all such requirements and regulations as applicable to the Work.

1.2.3 Requirements set out in this Section are for guidance and information and are not necessarily complete.

1.3 Codes and Standards

1.3.1 The Contractor will:

.1 Perform work in accordance with the latest named published editions of codes and standards.

.2 Provide material and workmanship, which meet or exceed the specifically named code or standard.

.3 Execute Work in accordance with the applicable Federal, Provincial, Territorial and Municipal statutes, laws, regulations to the location of the Work to be performed.

.4 In the event of conflict of above statutes, laws, regulations and codes execute work in accordance with the requirements of the Authority having jurisdiction.

.5 Enforce all safety measures in accordance with the Ontario Occupational Health and Safety Act and applicable local Construction Safety.

.6 Enforce all safety measures in accordance with the Workplace Hazardous Materials Information System (WHMIS).

.7 For the purpose of the Occupational Health and Safety Act, the Contractor for the Works will be designated “Constructor” and will assume the responsibility of the Constructor as set out in the Act and its regulations. The Engineer will monitor the quality and quantity of work, undertake progress payment inspections and inspections for compliance with specifications and plans. The Owner will NOT be a “Constructor” by reason thereof.

.8 Provide the Director of Construction Health and Safety Branch of the Ministry of Labour with the information required under the Occupational Health and Safety Act prior to commencing work.

1.4 Permits

1.4.1 The Owner will apply for, obtain and pay for all permits required for the Works, including but not limited to:

.1 All utilities approvals.

.2 Ministry of the Environment, Conservation and Parks

.3 Building permit.

.4 Permits to Take Water.

.5 Ministry of Consumers and Commercial Relations.

.6 Ministry of Labour.

.7 Ministry of Environment

.8 Local Region Conservation Authority

1.4.2 The Contractor will arrange for and inform the Engineer of inspections required by building permits, TSSA, ESA or any other Regulatory body requiring inspection.

1.4.3 The Contractor will arrange for and inform the Engineer of all other regular and final inspections required.

1.4.4 The Contractor will be responsible for all payments for the inspections as required for the permits.

1.5 Work in Vicinity of Overhead Power Lines

1.5.1 Contractor to confirm the setback requirements for operation near power lines with local utility.

1.5.2 Request Power Company to relocate, de-energize or guard any energized conductor where construction equipment may operate within 3 m of conductor.

1.5.3 Obtain Power Company approval prior to operating any equipment within 3 m of energized conductor.

1.5.4 Where practical, avoid storage of metallic pipe sections under high voltage overhead power lines.

1.5.5 If pipe sections must be stored under power lines, protect personnel from effects of induced currents by grounding pipe sections at two (2) locations with AWG #2 copper ground conductors and grounding rods.

1.5.6 Complete and submit applicable WSIB Forms prior to commencement of work.

1.5.7 Provide appropriate signs where required as per OSHA Section 44, 3(e)

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Intent of Section

1.1.1 This section provides a list of references, standards and organizations that may be referred to throughout these documents by an abbreviation. The abbreviations and details on the organization and contact information are provided in this section.

1.2 References

1.2.1 AA Aluminum Association, 900 19th Street N.W., Washington, D.C., U.S.A. 20006 http://www.aluminum.org.

1.2.2 AASHTO American Association of State Highway and Transportation Officials, 444 N Capitol Street N.W., Suite 249, Washington, D.C., U.S.A. 20001 http://www.aashto.org.

1.2.3 ACI American Concrete Institute, P.O. Box 9094, Farmington Hills, Michigan U.S.A. 48333

1.2.4 AHA American Hardboard Association, 887 B Wilmette Road, Palatine, Illinois, U.S.A. 60067

1.2.5 AITC American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, Colorado, U.S.A. 80112

1.2.6 AMCA Air Movement and Control Association Inc., 30 West University Drive, Arlington Heights, Illinois, U.S.A. 60004 1893 http://www.amca.org

1.2.7 ANSI American National Standards Institute, 11 West 42nd Street, New York, New York, U.S.A. 10036 http://www.ansi.org

1.2.8 API American Petroleum Institute,1220 L St. Northwest, Washington, D.C., U.S.A. 20005 4070 http://www.api.org

1.2.9 ARI Air Conditioning and Refrigeration Institute, 1815 North Fort Myer Drive, Arlington, Virginia, U.S.A. 22209 http://www.ari.org

1.2.10 ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, Georgia, U.S.A. 30329 http://www.ashrae.org

1.2.11 ASME American Society of Mechanical Engineers, United Engineering Centre, 345 East 47th Street, New York, New York, U.S.A. 10017 2392 http://www.asme.org

1.2.12 ASTM American Society for Testing and Materials, 100 Barr Harbor Drive West, Conshohocken, Pennsylvania 19428 2959 http://www.astm.org

1.2.13 AWCI Association of the Wall and Ceiling Industries, 1711 Connecticut Avenue N.W., Washington, D.C. U.S.A. 20009 http://www.awci.org

1.2.14 AWMAC Architectural Woodwork Manufacturers Association of Canada, 516 4 Street West, High River, Alberta T1V 1B6 http://www.awmac.com

1.2.15 AWS American Welding Society, 550 N.W. LeJeune Road, Miami, Florida U.S.A. 33126 http://www.amweld.org

1.2.16 AWWA American Water Works Association, 6666 W. Quincy Avenue, Denver, Colorado, U.S.A. 80235 http://www.awwa.org

1.2.17 CFFM Canadian Forces Fire Marshal, 101 Colonel By Drive, 8NT MGen George R. Pearkes Bldg., Ottawa, Ontario K1A 0K2

1.2.18 CGA Canadian Gas Association, 243 Consumers Road, Suite 1200, North York, Ontario M2J 5E3 http://www.cga.ca

1.2.19 CGSB Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 http://w3.pwgsc.gc.ca/cgsb

1.2.20 CISC Canadian Institute of Steel Construction, 201 Consumers Road, Suite 300, Willowdale, Ontario M2J 4G8

1.2.21 CITC Canadian Institute of Timber Construction, 200 Cooper Street, Ottawa, Ontario K2P 0G1

1.2.22 CMB Construction Materials Board, 101 Colonel By Drive, 8NT MGen George R. Pearkes Bldg., Ottawa, Ontario K1A 0K2

1.2.23 COFI Council of Forest Industries, 555 Burrard, Suite 1200, Vancouver, B.C. V7X 1S7 http://www.cofi.org

1.2.24 CRCA Canadian Roofing Contractors Association, 151 Slater Street, Suite 606, Ottawa, Ontario K1P 5H3

1.2.25 CSA Canadian Standards Association, 178 Rexdale Blvd., Etobicoke, Ontario M9W 1R3 http://www.csa.ca

1.2.26 CSC Construction Specifications Canada, 100 Lombard Street, Suite 200, Toronto, Ontario M5C 1M3

1.2.27 CSDFMA Canadian Steel Door and Frame Manufacturing Association One Yonge Street, Suite 1400, Toronto, Ontario M5E 1J9

1.2.28 CSPI Corrugated Steel Pipe Institute, 201 Consumers Road, Suite 306, Willowdale, Ontario M2J 4G8

1.2.29 CSSBI Canadian Sheet Steel Building Institute, 201 Consumers Road, Suite 305, Willowdale, Ontario M2J 4G8 http://www.cssbi.ca

1.2.30 CWC Canadian Wood Council, 1400 Blair Place, Suite 210, Ottawa, Ontario K1J 9B8 http://www.cwc.ca

1.2.31 EEMAC Electrical and Electronic Manufacturers' Association of Canada, 1 Yonge Street, Suite 1608, Toronto, Ontario M5E 1R1 http://www.electro.ca

1.2.32 FCC Fire Commissioner of Canada, Place du Portage, Phase II, 165 rue Hotel de Ville, Hull Quebec K1A 0J2

1.2.33 ICPI Interlocking Concrete Pavement Institute, P.O. Box 23053, Milton, Ontario L9T 2M0 http://www.icpi.org/icpi

1.2.34 IEEE Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, New York U.S.A. 10017

1.2.35 MTO - Ministry of Transportation Ontario.

1.2.36 MECP – Ministry of the Environment, Conservation and Parks.

1.2.37 MSS Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, Virginia U.S.A.22180

1.2.38 NAAMM National Association of Architectural Metal Manufacturers, 8 South Michigan Avenue, Suite 1000, Chicago, Illinois U.S.A. 60603 http://www.naamm.org

1.2.39 NBC – National Building Code.

1.2.40 NFC – National Fire Code.

1.2.41 NEMA National Electrical Manufacturers Association, 1300 N. 17th Street, Suite 1847, Rosslyn, Virginia 22209 http://www.nema.org

1.2.42 NFPA National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts, U.S.A. 02269 9101 http://www.nfpa.org

1.2.43 NFSA National Fire Sprinkler Association, P.O. Box 1000, Patterson, New York, U.S.A. 12563 http://www.nfsa.org

1.2.44 NHLA National Hardwood Lumber Association, P.O. Box 34518, Memphis, Tennessee, U.S.A 38184 0518 http://www.natlhardwood.org

1.2.45 NLGA National Lumber Grades Authority, 260 1055 West Hastings, Vancouver, B.C. V6E 2E9

1.2.46 NRC National Research Council, Montreal Road, Ottawa, Ontario K1A 0S2

1.2.47 NSF International – P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, Michigan 48105, USA http://www.nsf.org

1.2.48 OBC – Ontario Building Code.

1.2.49 PCI Prestressed Concrete Institute, 175 W. Jackson Blvd., Suite 1859, Chicago, Illinois, U.S.A. 60604 http://www.pci.org

1.2.50 QPL Qualification Program List, c/o Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 http://w3.pwgsc.gc.ca/cgsb

1.2.51 SAE Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096 0001 http://www.sae.org

1.2.52 SCC Standards Council of Canada, 1200 45 O'Connor Street, Ottawa, Ontario K1P 6N7 http://www.scc.ca

1.2.53 SMACNA Sheet Metal and Air Conditioning Contractors' National Association, 4201 Lafayette Center Drive, Chantilly, Virginia 20151 1209 http://www.smacna.org

1.2.54 SSPC Steel Structures Painting Council, 40 24th Street, Pittsburgh, Pennsylvania 15222 4656 http://www.sspc.org

1.2.55 TTMAC Terrazzo, Tile and Marble Association of Canada, 30 Capston Gate, Unit 5 Concord, Ontario L4K 3E8 http://www.ttmac.com

1.2.56 UL Underwriters' Laboratories, 333 Pfingsten Road, Northbrook, Illinois, U.S.A. 60062 http://www.ul.com

1.2.57 ULC Underwriters' Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario M1R 3A9 http://www.ulc.ca

1.2.58 USACE United States Army Corps Engineers, Huntsville, Alabama http://www.hnd.usace.army.mil

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.

1.2 Inspection

1.2.1 Allow the Engineer access to the Works at all times. If part of Work is prepared at locations other than the job site, allow access to such work whenever it is in progress.

1.2.2 Give timely notice requesting inspection if work is designated for special tests, inspections or approvals by the Engineer instructions.

1.2.3 If the Contractor covers or permits to be covered, work that has been designated for special tests, inspections or approvals before such is made, uncover such work, have inspections or tests satisfactorily completed and make good such work.

1.2.4 The Engineer may order any part of the Works to be examined if work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such work and pay cost of examination and correction. If such work is found in accordance with Contract Documents, the Owner will pay the cost of examination.

1.3 Independent Inspection Agencies

1.3.1 The Owner and/or Engineer may engage a Testing Laboratory or Independent Inspection/Testing Agencies for the purpose of inspecting and/or testing portions of Work. The cost of such services will be borne by the Owner.

1.3.2 Provide equipment required for executing inspection and testing by appointed agencies.

1.3.3 Employment of inspection/testing agencies does not relieve the Contractor from responsibility to perform work in accordance with the Contract Documents.

1.3.4 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain the full degree of the defect. Correct defect and irregularities as advised by the Engineer at no cost to the Owner. The Contractor is to pay costs for retesting and re-inspection.

1.4 Pre-Construction Survey

1.4.1 Undertake a survey of existing surface finish conditions.

1.4.2 Document findings with photographs and in writing.

1.4.3 Turn over one copy, with original photographic prints, to the Engineer at the commencement of construction.

1.5 Leakage Tests

1.5.1 Test all liquid holding structures for leakage by filling with water to the maximum level as shown on the Drawings.

1.5.2 Repair all visible damage prior to filling the structure with water.

1.5.3 The Contractor shall be responsible for coordinating the supply of water for the leakage tests and for transferring water from one structure to the next for leakage test purposes.

1.5.4 Test each liquid holding structure separately for a period of 48 hours. The total leakage from any liquid holding structure for a period of 48 hours, shall be zero percent (0%) of the volume of water contained therein. If the test shows leakage in any liquid holding structure to exceed that specified, empty structure, carefully examine and repair defects by an approved method.

1.5.5 Repeat test until leakage is less than the specified amount.

1.5.6 Complete leakage tests and reduce leakage to the specified limit before applying waterproofing or placing the structure into service, whichever comes first.

1.5.7 After installation of the connecting pipe work the Owner will supply sufficient water from the existing system to carry out the first test. Should any subsequent tests be required, water will be supplied, but at the Contractor's expense.

1.5.8 Contractor shall conduct leakage tests on water retaining structures to the satisfaction of the Engineer.

1.6 Access to Work

1.6.1 Allow inspection/testing agencies access to the Works, off-site manufacturing and fabrication plants. Cooperate to provide reasonable facilities for such access.

1.7 Procedures

1.7.1 Notify appropriate agency and the Engineer in advance of requirement for tests, in order that attendance arrangements can be made.

1.7.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in work.

1.7.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.8 Rejected Work

1.8.1 Remove defective work, whether a result of poor workmanship, use of defective products or damage and whether incorporated in work or not, which has been rejected by the Engineer as failing to conform to Contract Documents. Replace or re execute in accordance with Contract Documents.

1.8.2 Make good other contractor's work damaged by such removals or replacements promptly.

1.8.3 If it is the opinion of the Engineer that it is not expedient to correct defective work or work not performed in accordance with the Contract Documents, the Owner may deduct from Contract Price difference in value between work performed and that called for by Contract Documents, amount of which shall be determined by the Engineer.

1.9 Tests and Mix Designs

1.9.1 Furnish test results and mix designs as may be requested. The cost of tests and mix designs beyond those called for in Contract Documents shall be appraised by the Engineer and may be authorized as recoverable.

1.10 Layout of Work

1.10.1 Where systems, piping and/or equipment are concentrated in a small work area, prepare a sketch or layout of the work to define potential conflicts or challenges in work sequencing, as requested by the Engineer.

1.10.2 Plan the total installation by preparing a minimum 1:50 scale reproduceable interference drawing detailing the location and identifying each system to the Engineer for review. Include for work of all disciplines on drawing.

1.10.3 Install systems and products to provide the maximum headroom, clearances for access, specified floor to ceiling heights, and to minimize offsets in pipes, conduit, ducts and structural framing.

1.10.4 Run pipes, ducts, tubing and conduit plumb or level (except where specific slope is required for proper function) and parallel with building surfaces.

1.10.5 Notify the Engineer and request clarification if locations of fixtures, fittings, equipment and services to these items interfere with interior finishes and use of the work.

1.11 Mill Tests

1.11.1 Submit mill test certificates as required of Specifications Sections or as requested by the Engineer.

1.12 Equipment and Systems

1.12.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

1.13 Minimum Standard

1.13.1 The Specifications and the Contract Drawings define a minimum standard of Workmanship. The Contractor shall include in the Tender, the cost of any additional work or improvements in the quality of the Works that the Contractor considers necessary to unconditionally guarantee the performance of the completed work in conformity with the Contract through the Warranty Period.

1.14 Workmanship

1.14.1 The quality of the workmanship and finished product shall present a neat and attractive appearance when finished.

1.14.2 If ordered by the Engineer, the Contractor shall make enough openings in the Works and/or materials as are necessary to inspect the works.

1.14.3 Should the Engineer find the work and/or materials so opened up to be faulty in any respect, the Contractor shall remove and make good all defective work and/or materials and shall bear the expense of all such opening, inspecting, and making good.

1.14.4 Should the Engineer find the work and/or materials so opened up to be in acceptable condition, the expense of such opening and closing will be borne by the Owner.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Section Includes

1.1.1 Temporary utilities for the work including power, water, heating, ventilation, telephone and internet communication to be used during construction.

1.1.2 The Contractor shall install all temporary utilities.

1.1.3 The Owner will pay for all temporary hydro utility and water bills.

1.2 Installation and Removal

1.2.1 Provide temporary utilities and controls in order to execute work properly, safely and expeditiously.

1.2.2 Remove all temporary works from site after use, unless otherwise directed by the Engineer or specified in this specification. Work for the Engineer's site office will not be removed.

1.2.3 Make all necessary applications, obtain permits and pay for all hook-ups, fees, charges for service and use.

1.3 Localized Unwatering

1.3.1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water. Unwatering pumps shall be electrical to keep the noise of running motors to a minimum.

1.3.2 Dispose of all groundwater and surface water runoff in a manner approved by the Engineer and Owner, as per Section 01400 – Environmental Protection.

1.4 Temporary Water Supply

1.4.1 The Contractor shall make arrangements with the Owner for a continuous supply of potable water for construction use. The Contractor shall connect to water supply and meter this supply for record and billing purposes. The Contractor must employ all reasonable steps and precautions to conserve water supplied. The connection point and method of connection will be subject to the approval of the Engineer and the Owner. *A* backflow prevention device must be supplied and installed at the point of connection by the Contractor.

1.4.2 Enough water will be provided once only by the Owner for the purpose of disinfecting the following facilities:

.1 All yard, process piping, process equipment, intake well, screen wells, screened water well and low lift wells.

1.4.3 Should the initial attempt at disinfecting not pass all testing requirements as stipulated by the Contract Documents and additional water for disinfecting purposes will be provided by the Owner at the Contractor's sole expense.

1.5 Temporary Heating and Ventilation

1.5.1 Any construction heaters used inside a building must be vented to the outside or be flameless type. Solid fuel salamanders are not permitted.

1.5.2 Provide temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate progress of the Works.

.2 Protect the Works and products against dampness and cold.

.3 Prevent moisture condensation on surfaces.

.4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.

.5 Provide adequate ventilation to meet health regulations for safe working environment.

1.5.3 Maintain inside temperatures above a minimum of 10°C in areas and adjacent to areas where construction is in progress or ongoing.

1.5.4 Ventilating:

.1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

.3 Dispose of exhaust materials in a manner that will not result in harmful exposure to persons.

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Ventilate temporary sanitary facilities.

.6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

1.5.5 The Contractor shall provide its own temporary heating and ventilation system to facilitate construction of the Works. If permitted by the Owner, the Contractor may use the permanent heating and ventilation system of the Facility. Be responsible for damage to heating and ventilation system if use is permitted. If the permanent heating and ventilation system is used, then all maintenance requirements for the system shall be performed by the Contractor. The Contractor shall perform maintenance as recommended by the system manufacturer and required by the Owner. All maintenance activities performed by the Contractor shall be documented and submitted to the Engineer and Owner.

1.5.6 Substantial Performance will not be issued until the entire system is as near original condition as possible and is certified by the Engineer.

1.5.7 Maintain strict supervision of operation of temporary heating and ventilating equipment to:

.1 Conform with applicable codes and standards.

.2 Enforce safe practices.

.3 Prevent abuse of services.

.4 Prevent damage to finishes.

.5 Vent direct-fired combustion units to outside.

1.5.8 Be responsible for damage to the Works due to failure in providing adequate heat and protection during construction.

1.6 Temporary Power and Light

1.6.1 The Contractor will make arrangements to provide and pay for all temporary power during construction required for temporary lighting and operation of power tools and equipment necessary to complete the Work.

1.6.2 The Contractor may provide their own portable generators for power generation, inclusive of fuel, operation and maintenance, size appropriately for the intended work. The generator must be noise attenuated to 45 dB units from at least five metres distance under any operating condition.

1.7 Temporary Communication Facilities

1.7.1 The Contractor will provide and pay for a high-speed internet service and related equipment necessary for the Contractor's and Engineer's own uses and to facilitate on-line project collaboration.

1.8 Fire Protection

1.8.1 Provide and maintain temporary fire protection equipment during performance of the Works required by governing codes, regulations and bylaws.

1.8.2 Burning rubbish and construction waste materials is not permitted on site.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Security

1.1.1 The Contractor shall assume overall responsibility for security of the site, during construction. Security deemed necessary for protection against loss or damage of any equipment on site in relation to the project shall be the sole responsibility of the Contractor.

1.1.2 Confine work and operations of employees as required by Contract Documents. Do not unreasonably encumber premises with products.

1.1.3 Prohibit the committing of nuisance on the site and any employee found violating such a provision shall be promptly discharged.

1.1.4 Positive visual identification shall be worn at all times and be monitored by the Engineer. Any person without valid identification will be removed from the site. No additional cost shall be incurred by the Owner for persons removed from site.

1.2 Sanitary Facilities

1.2.1 Provide sufficient sanitary facilities for all persons employed on the Contract subject to approval of type, size and location by the local health authorities and the Engineer.

1.2.2 Maintain facilities with all required toilet room supplies in a clean and sanitary condition and disinfect frequently.

1.2.3 Leave site in a clean sanitary condition.

1.3 Construction / Engineer Offices

1.3.1 Provide one 10’ x 10’ office.

1.3.2 Furnish equipment specified for exclusive use of the Owner and Engineer.

1.3.3 Ownership of equipment furnished under this article will remain, unless otherwise specified, that of the Contractor.

1.3.4 Equipment furnished shall be new or when approved by the Owner like new in appearance and function.

1.3.5 Provide all required temporary utilities.

1.3.6 Provide field offices inspected and approved by the Ontario Electrical Safety Authority. Obtain Building Permits as required by Ontario Building Code (OBC).

1.3.7 Provide stairs and landings in accordance with the OBC.

1.3.8 Minimum Features:

.1 120 V lighting and wall plugs.

.2 Fluorescent ceiling lights.

.3 Electric heating and self contained air conditioning unit, properly sized for project locale and conditions. Provide ample electric power to operate installed systems. Size heating for internal temperature of 21 degrees C, outside temperature of minus 25 degrees C, and allowance of 100 per cent of calculated heat load for infiltration.

.4 Railed stairways and landings at entrances.

.5 Weatherproof, insulated.

.6 Doors to be fitted with cylinder locks, with the Engineer in possession of all keys.

.7 Parking space to accommodate a minimum of one vehicle

.8 Sanitary Facilities:

.1 One sanitary facility to be flush type with hot and cold water and drains, electric water heater, all required supplies and to have a latch with a padlock on the doors, with access for Owner and cleaning staff only.

.9 Exterior Door(s):

.1 Number: One.

.2 Type: Solid core.

.3 Lock(s): Cylindrical; keyed alike.

.10 Number of Windows: Two, complete with fly screens.

.11 Minimum Interior Height: 2.4 m.

1.3.9 Floor Space: minimum 100 sq ft.

1.3.10 If Engineer's office is to be located in the same structure as the Contractor's superintendent's office, it shall be partitioned off and provided with separate, lockable entrances.

1.3.11 Trailer Type Mobile Structure: As manufactured by Armstrong, Miller, or Atco.

1.3.12 All metal frame; all metal exterior, sides, and roof; and insulated double walls, floor, and roof.

1.3.13 Security guard screens on all windows.

1.3.14 Electric exhaust fan for lavatory, minimum 1.0 m^3/min capacity, complete with backdraft damper.

1.3.15 Field Office Equipment General:

.1 Bottled Water Service: One, with cooler that can produce both hot water and cold water.

.2 Refrigerator: One.

.3 Microwave: One.

.4 Coffeemaker: One.

.5 Kettle: One.

.6 Desk: One steel, 750 mm by 1500 mm with desk surface located 740 mm from floor.

.7 Computer Chair: One with the following characteristics:

.1 Five castor base.

.2 Adjustable height.

.3 Swivels.

.4 Locking Back.

.5 Adjustable seat back for height and angle.

.6 Adjustable arms.

.8 Lockable Storage Cabinet: One, 900mm by 2100mm by 400mm.

.9 Clothes Rack: One.

.10 First Aid Kit: One.

.11 Carbon Dioxide (10 Pound) Fire Extinguisher: One.

.12 Multifunction Colour Printer/Copier, dry type, self-feeding, able to print 11 inch by 17 inch, 8 1/2 inch by 11 inch, and 8 1/2 inch by 14 inch copies and collating multiple copies, reduction and enlargement capabilities; connected to internal network, include maintenance service agreement including all required supplies for the duration of contract. HP9040MFP or approved equal.

1.3.16 Sign on entrance door reading “BLIND RIVER WATER TREATMENT PLANT INTAKE AND LOW-LIFT PUMPING STATION ENGINEER’S FIELD OFFICE”, letter height 100 mm minimum. Sign shall be lit.

1.3.17 Property and Contents Insurance – The Engineer’s trailers shall be insured and all contents shall be insured for replacement value. Details of the insurance to be provided by the Contractor shall be approved by the Owner prior to provision of the field offices.

1.3.18 Make available for Engineer’s use prior to start of the Work at site, to remain on the site for minimum of 30 calendar days after final acceptance of the Work.

1.3.19 Locate where directed by the Engineer and as shown on the Contract Documents; level, block, tie down, skirt, provide stairways, and relocate when necessary and approved. Construct on proper foundations, provide proper surface drainage and connections for utility services.

1.3.20 Raise grade under field office, as necessary, to elevation adequate to avoid flooding.

1.3.21 Provide sanitary facilities in compliance with provincial and local health authorities and Ontario Regulation 659/79.

1.3.22 Maintain in good repair and appearance, and provide daily cleaning service and replenishment, as required, of paper towels, paper cups, hand soap, toilet paper, first-aid kit supplies, and bottled water.

1.3.23 Replenish, as needed, facsimile paper, copier paper, ink and toner.

1.3.24 Cleaning

.1 Maintain sanitary facilities in compliance with provincial and local health authorities and Ontario Regulation 659/79.

.2 Provide twice weekly cleaning services for the duration of the contract once the Project office has been furnished and occupied by the Engineer.

.3 The cleaning service shall only be completed outside of regular office hours.

.4 The cleaning service shall clean all areas of the project office with the exception of the truck bays.

.5 Provide and maintain cleaning supplies at all times within the project office for the usage of the Engineer or Owner.

.6 Provide and maintain supplies for all washrooms.

1.3.25 Landscaping and Maintenance

.1 Provide year-round landscaping and exterior maintenance including, but not limited to grass cutting, snow removal, and general landscaping at the project office.

1.3.26 Provide pest and rodent control.

1.3.27 Arrange and pay (including monthly rentals) for the duration of the contract and issuance of final certificate:

.1 High speed Internet connection or stick complete with required hardware, software, installation and setup for the Engineer's site representatives. Contractor to arrange and pay monthly costs for service.

1.3.28 Maintain documents and materials on-site, in the construction office, in accordance with these specifications.

1.3.29 Maintain documents in order and make available for viewing by Engineer and Ministry of Labour Inspector at all times.

1.4 Storage Sheds

1.4.1 Provide adequate weather tight sheds with raised floors, for storage of materials, tools and equipment, which are subject to damage by weather.

1.4.2 Provide heated storage structures.

1.4.3 Maintain storage sheds in a neat and clean condition.

1.5 Scaffolding and Supports

1.5.1 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs required to complete the work.

1.5.2 Do not load or permit the loading of any part of the Works with a weight or force that will endanger the Works.

1.6 Construction Parking

1.6.1 Parking will be permitted in areas as approved by the Engineer, provided it does not disrupt plant maintenance vehicles nor the performance of operations staff.

1.6.2 Provide and maintain adequate access to project site.

1.6.3 Snow removal to be performed and paid for by the Contractor at no additional cost to the Contract. Included in the cost of snow removal is the off-site disposal of accumulated removed snow, at a time deemed necessary by the Engineer.

1.6.4 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.

1.6.5 If existing access roads are maintained by the Owner including snow removal, do not store materials or modify the road that will affect snow clearing. Any damages resulting from the Contractors negligence will be the responsibility of the Contractor.

1.6.6 When site space is not adequate, arrange for and/or maintain additional off-site parking.

1.7 Hoisting

1.7.1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment.

1.7.2 All hoists and cranes shall be operated by qualified operators.

1.8 Temporary Barriers and Enclosures

1.8.1 Provide temporary barriers to prevent unauthorized entry to construction, site office and on-site parking areas, and to protect existing facilities and adjacent properties from damage from the Contractor’s operations.

1.8.2 Where appropriate, equipment barriers with vehicular and pedestrian gates with locks.

1.8.3 Provide security and facilities to protect the Work and the Site from unauthorized entry, vandalism and theft.

1.8.4 Maintain a log of workers and visitors and make the log available to the Engineer upon request. Include the date, name, address and company employed by, company/ person invited, time in and time out for each person, and record deliveries and security incidents.

1.9 Temporary Connections and Staging of Work

1.9.1 The Contractor is fully responsible for the installation, maintenance and eventual removal of the all temporary connections required to complete the works.

1.9.2 A staging and shutdown plan for these connections must be prepared and submitted to the Engineer for approval at least 14 days in advance of this work.

1.10 Removal of Temporary Facilities and Controls

1.10.1 Remove temporary utilities, equipment, facilities, materials prior to the Substantial Performance inspection.

1.10.2 Remove underground installations to a minimum depth of 600 mm. Grade and restore the Site as indicated on the drawings or in the specifications.

1.10.3 Clean and repair damage caused by installation or use of temporary work. Restore existing facilities used during construction to their original and functional condition

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section provides the general equipment stipulations that apply to all products, materials and equipment provided for this contract. These requirements are in addition to the detailed requirements that may be covered under individual equipment specification or manufacturer specific requirements.

1.2 Reference Standards

1.2.1 Conform to standards, in whole or in part as requested in each of the specifications.

1.2.2 If there is a question as to whether any product or system is in conformance with applicable standards, the Engineer reserves the right to have such products or systems tested to prove or disprove conformance.

1.2.3 The cost for such testing will be borne by the Owner in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.

1.2.4 Conform to the latest date of issue of referenced standards in effect on date of submission of Tender, except where specific date or issue is specifically noted.

1.3 Quality

1.3.1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in the Works shall be new, not damaged or defective, and of best quality (compatible with specifications) for purposes intended. If requested, furnish evidence as to type, source and quality of products provided.

1.3.2 Defective products identified prior to completion of the Work will be rejected regardless of previous inspections. Inspection by the Engineer or any agent of the Owner at no time relieves the Contractor from responsibility for the supply of acceptable quality products.

1.3.3 Remove and replace defective products at own expense and be responsible for delays and expenses caused by the rejection of defective products.

1.3.4 Should any dispute arise as to the quality or fitness of any products, the decision to accept the product(s) rests strictly with the Engineer based upon the requirements of the Contract Documents.

1.3.5 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Works.

1.3.6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.4 Availability

1.4.1 Immediately upon signing the Contract, review the product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are

foreseeable, notify the Engineer of such, in order that substitutions or other remedial action may be considered and authorized in ample time to prevent delay in performance of the work.

1.4.2 In the event of failure to notify the Engineer at commencement of the Works and, should it subsequently appear that the Works may be delayed for such reason, the Engineer reserves the right to substitute more readily available products of similar character, at no increase in the Contract Price or at no change to the Contract Time.

1.5 Storage, Handling and Protection

1.5.1 Handle and store products in a manner so as to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions.

1.5.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until they are to be incorporated in the Works.

1.5.3 Store products subject to damage from weather in weatherproof enclosures.

1.5.4 Store cementitious products clear of earth or concrete floors, and away from walls.

1.5.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

1.5.6 Store sheet materials, lumber and drywall on flat, solid supports and keep clear of ground. Slope to shed moisture.

1.5.7 Store and mix paints in heated and ventilated areas. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

1.5.8 Remove and replace damaged products at own expense and to the satisfaction of the Engineer.

1.5.9 Touch-up damaged factory finished surfaces to the Engineer's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.6 Transportation

1.6.1 Pay the costs of transportation of products required in performance of the Works.

1.6.2 Transportation cost of products supplied by the Owner will be paid for by the Owner.

1.6.3 Unload, handle and store such products at the Works.

1.7 Manufacturer's Instructions

1.7.1 Unless otherwise indicated in the specifications, always install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

1.7.2 Notify the Engineer in writing of conflicts between Specifications and manufacturer's instructions. The Engineer will clarify or establish the most appropriate solution to the conflict.

1.7.3 Improper installation or erection of products, due to failure in complying with manufacturer's instructions, authorizes the Engineer to require removal and re-installation at no increase in the Contract Price or at no change to the Contract Time.

1.8 Quality of Work

1.8.1 Ensure Quality of the Works is of the highest standard and is executed by workers experienced and skilled in their respective duties for which they are employed. Immediately notify the Engineer if the nature of the work is such as to make it impractical to produce required results.

1.8.2 Do not employ anyone unskilled in their required duties. The Engineer reserves the right to require dismissal from the Works of any workers deemed incompetent or careless.

1.8.3 Decisions as to standard or fitness or the Quality of Work, in cases of dispute, rest solely with the Engineer, whose decision is final.

1.9 Coordination

1.9.1 Ensure the cooperation of all work in the layout of the Works. Maintain efficient and continuous supervision over the entire works.

1.9.2 Be responsible for construction and placement of openings, sleeves, accessories and any materials or work necessary to fully coordinate all of the Works outlined in the Specifications.

1.9.3 Before installation, inform the Engineer of all potential interferences and complete installation as directed by the Engineer.

1.10 Concealment

1.10.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings or as indicated on drawings and specifications.

1.11 Remedial Work

1.11.1 Perform remedial work required to repair or replace parts or portions of the Works identified as defective or unacceptable. Coordinate adjacent affected work as required.

1.11.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of the Works.

1.12 Locations of Fixtures

1.12.1 Consider location of fixtures, outlets and mechanical and electrical items indicated as approximate. Fully coordinate their final placement and positioning.

1.12.2 Where in doubt, or in the case of potential interferences, inform the Engineer and install as directed.

1.13 Material Fasteners

1.13.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless otherwise indicated.

1.13.2 Prevent electrolytic action between dissimilar metals and materials by providing isolation kits, gaskets or some other manner of isolation as directed by Engineer.

1.13.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other materials are specifically requested in the affected Specifications. This clause will only apply if fastener and anchor material is not identified elsewhere.

1.13.4 Space anchors within the individual load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood or any other organic material plugs are not acceptable.

1.13.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

1.13.6 Fastenings that cause spalling or cracking of material to which anchorage is made, are not acceptable.

1.14 Equipment Guards

1.14.1 Provide approved securely mounted equipment guards suitably reinforced and neatly formed of at least 12 gauge steel perforated sheet or expanded sheet metal for couplings, belts, chain drives, extended shafts and around all moving parts.

1.14.2 Eliminate sharp edges with suitable borders neatly welded to perforated sheet.

1.14.3 Provide guards hot-dip galvanized after fabrication.

1.15 Base Plates

1.15.1 Mount equipment and driver on a common base plate in a compact arrangement.

1.15.2 Provide equipment base plates complying with the OSHA of heavy cast iron or of welded structural steel section at least 13 mm thick. Provide mounting plates at least 19 mm thick for mounting equipment and driver. Machine surfaces for mounting equipment and driver to an arithmetical average roughness height of less than 2.8 mm

1.15.3 Provide closed base plates suitable for grouting. Provide grout holes, vent holes and anchor bolt holes in the base plates.

1.15.4 For equipment where leakage or condensation may occur, provide base plates with a drip lip and drain connections to the exterior of the base. Provide bossed connections to drip lips below the gutter invert and at least, 25 mm N.P.T. Provide piping from the drain connections to the building drainage system.

1.16 Nuts and Bolts

1.16.1 Unless specified otherwise, use U.S. standard hexagonal nuts and bolts for bolted connections. Project bolt ends beyond the nut faces at least 3 mm but not more than 1 bolt diameter. Use cadmium plated bolts and nuts on stainless steel flanges; provide stainless

steel washers under bolt head and nut; use cadmium plated steel bolts and nuts on black steel and cast flanges.

.1 Use 316 SS nuts, washers and bolts when used in a submersible application and high humidity condition

1.17 Equipment Anchorage

1.17.1 Use anchors of standard commercial sizes and patterns with material and finish suitable for service.

1.17.2 Use heavy hexagon head bolts, semi-finished unless otherwise specified or required by the vendor. Use No. 304 stainless steel as a minimum for all areas unless indicated otherwise on the Contract Drawings or affected specifications.

1.17.3 Anchor bolts shall not project more than one diameter beyond nuts.

1.17.4 Use No. 304 SS type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.18 Protection of Work In Progress

1.18.1 Adequately protect the work completed or in progress. Work damaged or defaced, due to a failure to provide protection, is to be removed and replaced, or repaired, as directed by the Engineer, at no increase in the Contract Price or at no change to the Contract Time.

1.18.2 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of the Engineer.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section describes the cleaning requirements for the project site.

2 EXECUTION

2.1 Project Cleanliness

2.1.1 Maintain the Works in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner or other contractors.

2.1.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by the Engineer. Do not burn waste materials on site.

2.1.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

2.1.4 Provide onsite drum containers for collection of waste materials and debris.

2.1.5 Provide and use clearly marked separate bins for recycling.

2.1.6 Remove waste material and debris from site and deposit in waste container at end of each working day.

2.1.7 Dispose of waste materials and debris off site.

2.1.8 Clean interior areas prior to the start of finish work and maintain areas free of dust and other contaminants during finishing operations.

2.1.9 Store volatile waste in covered metal containers and remove from premises at the end of each working day.

2.1.10 Provide adequate ventilation while using volatile or noxious substances. The use of building ventilation systems is not permitted for this purpose.

2.1.11 Use only cleaning materials recommended by the manufacturer of the surface to be cleaned, and as recommended by the cleaning material manufacturer.

2.1.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces and will not contaminate building systems or electrical or control panels.

2.2 Final Cleaning

2.2.1 Prior to Substantial Performance or Completion or the Works, remove surplus products, tools, construction machinery and equipment not required for performance of remaining work.

2.2.2 Remove waste products and debris other than that caused by others, and leave the Works clean and suitable for occupancy.

2.2.3 Remove waste products and debris other than that caused by the Owner or other contractors.

2.2.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

2.2.5 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

2.2.6 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

2.2.7 Clean lighting reflectors, lenses, and other lighting surfaces.

2.2.8 Vacuum clean and dust building interiors, behind grilles, louvres, screens and electrical control panels.

2.2.9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

2.2.10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces or grounds.

2.2.11 Remove dirt and other disfiguration from exterior surfaces caused by construction.

2.2.12 Clean, sweep and wash all paved or concrete areas affected by construction.

2.2.13 Clean equipment and fixtures to a sanitary condition and clean or replace filters of mechanical equipment.

2.2.14 Ensure downspouts, and drainage systems have not become blocked by construction activities. Clean and remove blockages if required.

2.2.15 Remove debris and surplus materials from crawl areas and other accessible concealed spaces

3 PRODUCTS (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Intent of Section

1.1.1 This section covers the flushing and disinfection of water retaining structures, and in-plant potable water process piping.

1.1.2 The Contractor shall be responsible to flush, test and sterilize all structures and pipework in such lengths or sections as the Engineer shall direct, and provide all labour, water, chemicals and chemical metering equipment, pumps, gauges, caps, stoppers, air release cocks, pipework and other apparatus required to complete the tests. The Contractor shall employ qualified specialists if necessary.

1.2 Acceptable Specialist Sub-contractor

1.2.1 The specialists shall be fully experienced in providing disinfection services of water retaining structures, and potable water process piping and shall provide references of disinfection work completed for other water treatment plant projects in Ontario if requested. Should the Contractor intend on completing the disinfection work themselves, they shall provide references of their experience to the Engineer for review and approval. The Engineer reserves the right to reject the Contractors experience and the Contractor shall use one of the acceptable specialist sub-contractors listed below at no extra cost to the Owner.

1.2.2 Acceptable Specialist Sub-contractors include:

.1 Corix Group of Companies

.2 Jackson-Tkach Inc.

.3 Canadian Pipeline Cleaning Inc.

.4 Engineer approved equal.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 Disinfection Standards

3.1.1 Infrastructure in continuous contact with potable water shall be disinfected in accordance with the requirements of the following ANSI/AWWA Standards:

ANSI/AWWA Standard	Standard Name
C651-05	AWWA Standard for Disinfection Water Mains
C652-11	AWWA Standard for Disinfection of Water-Storage Facilities

3.1.2 Should there be conflicts between the above-noted standards or with the specifications, the more stringent provisions shall apply between the two.

3.2 Disinfection of Water Retaining Structures

3.2.1 The Contractor shall submit a disinfection plan and methodology for all piping and water retaining structures for review by the Owner and the Engineer, at least 15 working days before disinfection is proposed to be carried out.

3.2.2 Prior to placing water retaining structures into service, the Contractor shall disinfect water retaining structures per this specification. All disinfection operations shall be supervised by the Engineer.

3.2.3 Disinfection of water retaining structures shall be carried out in accordance with the requirements of the appropriate standard referenced in the table above. There are three disinfection methods provided in the Standard, however, only **Method 2** or **Method 3** shall be used by the Contractor unless otherwise noted or agreed to by the Engineer and Owner.

3.2.4 Disinfection shall not commence until components have been cleaned and thoroughly flushed.

3.2.5 After the disinfection procedure is completed and before the facilities are placed in service, water shall be sampled and tested for chlorine residual and coliform organisms in accordance with the relevant standard.

3.3 Bacteriological Sampling and Testing

3.3.1 Before a water storage facility or treatment facility is placed in service, bacteriological sampling and testing shall be performed in accordance with the above-noted respective AWWA Standard, and Ontario Regulation 170/03.

3.3.2 The water samples for bacteriological testing shall be taken by the Operating Authority for the existing facility only.

3.3.3 The Operating Authority shall be responsible for sending the samples to a registered laboratory for testing.

3.3.4 Analytical fees for the initial round of sampling will be absorbed by the Operating Authority. The Contractor will be responsible for fees related to additional samples submitted due to failed results plus any costs associated with providing additional water.

3.4 Discharge of Chlorinated Water

3.4.1 Safely dispose of all chlorinated water from draining operations or used for testing, flushing or disinfecting waterworks.

3.4.2 Do not discharge any untreated chlorinated water into any storm sewer, watercourse or sanitary sewer.

3.4.3 A reducing agent to neutralize residual chlorine shall be applied to the chlorinated water used for the disinfection of treatment facilities and water retaining structures and piping prior to discharge to the environment, in accordance with the requirements of the appropriate above-noted AWWA Standard or MECP regulation. The Contractor will bear all associated costs with the materials and labour required for dechlorination and discharge of chlorinated water.

3.4.4 Approved dechlorinating agents:

.1 Hyrdogen Peroxide

.2 Sulphur Dioxide.

.3 Sodium Bisulphate.

.4 Sodium Metabisulphate.

3.4.5 In all cases, the wasted water must be neutralized to provide a total chlorine residual of less than 0.002 mg/L at the outfall where detrimental effects may be suffered by plants and/or animals in the natural environment. The Contractor is responsible for monitoring and testing the discharge of all wastewater in the presence of the Engineer. Should test results show a residual of greater than 0.002 mg/L, the discharge shall be ceased immediately, and the procedure modified to meet the requirement of less than 0.002 mg/L of total chlorine.

3.4.6 Notify the following authorities regarding the method to be used to dechlorinate potable water and obtain approval from the Engineer prior to discharge of any chlorinated water to the environment:

.1 For drainage ditches and storm sewers, notify the Owner.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This Section specifies requirements for work during the Warranty Period.

1.2 General

1.2.1 Provide all warranties outlined in the Contract Documents from the time of Completion of the Works as set out in the Completion Certificate. The Contractor is advised that the warranty period does not commence until the Completion Certificate has been issued by the Engineer. Substantial Performance does not qualify as Completion.

1.2.2 Perform warranty work required during progress of the work and during the Warranty Period. Reference section 01770 Closeout Procedures, 01780 Closeout Documents and GC 52 of General Conditions.

1.2.3 Extend warranties on any component of the work that is required to be placed in operation prior to Completion of the Works for the purpose of complying with the sequence of construction.

1.3 Submittals

1.3.1 Inform the Engineer in writing of the arrangements made for carrying out warranty work during the Warranty Period.

1.3.2 Provide a telephone number and address for receipt of notices relating to matters requiring action by the Contractor during the Warranty Period.

1.4 Inspection and Declaration of Final Completion

1.4.1 Request inspection for Final Completion no later than 10 working days before the expiry of the Warranty Period.

1.4.2 Participate in a joint inspection of the Works for the purpose of establishing Final Completion. Arrange for, coordinate and pay for any special access required to inspect the Works, such as the draining of tanks.

1.4.3 Review the status of all Warranty items carried out during the Warranty Period with the Engineer.

1.4.4 Complete all outstanding deficiencies, repair noted defects, complete all outstanding warranty items and obtain the Engineer's written agreement that all works are complete in accordance with the Contract Documents.

1.4.5 Apply for Final Completion.

1.5 Work during Warranty Period

1.5.1 Perform all warranty work required upon receipt of verbal or written notices from the Engineer.

1.5.2 Repair or make good settlements and defects on surfaces of backfilled trench or excavations.

1.5.3 Repair all damages to structures caused by settlement of ground adjacent to or over excavation.

1.5.4 Maintain all trees and shrubs either planted or relocated for the duration of the Warranty Period.

1.6 Repair by Owner

1.6.1 The Owner will, without giving notice to the Contractor, repair shrinkages or defects that are dangerous in nature, that constitute an extreme emergency or that affect the operation of the Works. The Contractor will be notified of less serious conditions prior to work being performed.

1.6.2 The Engineer will notify the Contractor of emergency work performed by the Owner.

1.6.3 The cost of labour, equipment and material to perform emergency work will be charged to the Contractor

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section includes procedures for the purpose of issuance of Substantial Performance and Completion of the Works.

1.2 Final Cleaning

1.2.1 Execute final cleaning per Section 01740 Cleaning prior to Substantial Performance of the Work.

1.2.2 Clean debris from drainage systems or swales.

1.2.3 Clean the Site; sweep paved areas and rake clean landscaped surfaces.

1.2.4 Maintain cleaning until acceptance by the Owner.

1.3 Restoration

1.3.1 As a minimum, restoration shall mean replacement, repairs, or reconstruction to a condition at least as good as or better than the condition prior to commencement of the Work.

1.3.2 Except where specifically required otherwise by other Sections, restore areas of the Work and areas affected by the performance of the Work to conditions that existed prior to commencement of the Work and to match condition of similar adjacent, undisturbed areas.

1.3.3 Ensure that restored areas match existing grade and surface drainage characteristics, except as otherwise specified, and ensure a smooth transition from restored surfaces to existing surfaces.

1.3.4 Do not alter original conditions without prior written approval from the Engineer.

1.3.5 Without limiting the generality of the foregoing or other requirements of the Contract Documents, preserve and protect existing features encountered at the Site during performance of the Work including, but not limited to buildings, wells, yard hydrants, structures, fences, utilities, access roads, grassed areas, trees and other graded or improved areas.

1.3.6 Utilize construction methods and procedures during performance of the Work which keeps disturbance and damage of whatever nature to existing conditions to the practical minimum. Where work necessitates root or branch cutting, do not proceed without the Engineer's prior approval.

1.3.7 Ensure that quality, grades, elevations, and the extent of bedding, cover, and other backfill materials including subgrades, finish grades, and thickness of materials for roadways are properly documented during their removal to ensure reconstruction to at least their original and functional condition.

1.3.8 Restoration Material: New, except as otherwise specified, not damaged or defective, and of the best quality for the purpose intended. Furnish evidence as to type, source, and quality of

materials or products furnished when requested by the Engineer or specified in other Sections.

1.3.9 Should any dispute arise as to the quality or fitness of materials, whether obtained on or off Site, whether previously inspected by the Engineer prior to use or not, the decision to use any material or product in the finished Works will rest solely with the Engineer.

1.3.10 Remove from the Site clean material not approved for reuse.

1.3.11 Handle and store products and materials in a manner to prevent damage, adulteration, deterioration, and soiling and in accordance with manufacturers' instructions when applicable.

1.3.12 Prior to commencement of restoration work, inform the Engineer of proposed material, methods, and procedures to repair, replace, or reconstruct disturbed, damaged, or suspected damage to the Work.

1.3.13 Perform cutting, fitting, remedial, and coordination work to make the several parts of the Work fit together.

1.3.14 Except as specified otherwise, dismantle and salvage materials for reuse where practicable.

1.3.15 Exercise due care when removing material for salvage. Repair or replace materials damaged through improper handling or through loss after removal.

1.3.16 Store and protect removed material approved for reuse in approved locations. Beginning of restoration work means acceptance of existing conditions.

1.3.17 Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to minimum condition specified.

1.4 Inspection and Declaration of Substantial Performance

1.4.1 Contractor's Inspection: The Contractor and all Subcontractors shall conduct an inspection of the Work, identify deficiencies and defects, and repair as required to conform to the Contract Documents.

1.4.2 Notify the Engineer in writing of satisfactory completion of the Contractor's Inspection and that corrections have been made and request the Engineer's Inspection.

1.4.3 Owner staff to attend inspection with Engineer and Contractor.

1.4.4 Completion: Submit a written certificate that the following has been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed to a dollar value per the General Conditions of the Contract.

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational.

.4 Electrical inspections and approvals are complete and submitted.

.5 All required documentation has been submitted per Section 01780.

.6 Operation of systems has been demonstrated to the Owner's personnel.

.7 All required training has been delivered.

.8 Work is complete and ready to be used for the purposes intended.

1.4.5 Agree to a list of outstanding work and deficiencies that do not affect Substantial Performance with the Engineer.

1.4.6 Apply for Substantial Performance.

1.5 Completion

1.5.1 Complete all remaining outstanding work and deficiencies within the timeframe stipulated in the Form of Tender or within the dollar value per the General Conditions of the Contract.

1.5.2 Final Inspection: When all the outstanding items and deficiencies that did not affect Substantial Performance have been completed, request final inspection of the Works by the Engineer and the Owner.

1.5.3 Complete any outstanding work or deficiencies arising out of the final inspection that are deemed to affect issuance of the Certificate of Completion and related Payment Certificate.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Description

This section provides requirements for:

1.1.1 As-Recorded drawings, samples, and specifications.

1.1.2 Equipment and systems.

1.1.3 Product data, materials and finishes, and related information.

1.1.4 Operation and maintenance data.

1.1.5 Spare parts, special tools and maintenance materials.

1.1.6 Warranties and bonds.

1.1.7 Final site survey.

1.2 Submission

1.2.1 Prepare instructions and data by personnel experienced in the maintenance and operation of described products and submit two hardcopies for the Engineer's review.

1.2.2 One copy will be returned with comments and one copy will be retained to assist the Engineer and will be returned after delivery of the final copies.

1.2.3 Revise the content of documents as required prior to final submittal.

1.2.4 Ensure spare parts, maintenance materials and special tools provided are new, undamaged and not defective, and of the same quality and manufacture as products provided in the Works.

1.2.5 If requested, furnish evidence as to type, source and quality of products provided.

1.2.6 Defective products will be rejected, regardless of any previous inspections by the Engineer or other agents of the Owner. Defective products to be replaced at the Contractor's expense.

1.2.7 Pay the costs of transportation related to replacement of defective products.

1.3 Operation and Maintenance Data

1.3.1 Manual

.1 An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual Sections of Divisions 02 to 16.

1.3.2 General

.1 Provide three hardcopies of documentation including as-constructed shop drawings to instruct the Owner's operations and maintenance staff in the operation and associated maintenance of each piece of equipment and system as supplied and installed. The following description is provided to the Contractor to describe the general requirements of the Operation and Maintenance Manuals. All information may not apply in all cases. Similarly, the Contractor may be required to provide additional information to adequately describe the equipment.

.2 The Contractor will prepare a skeleton of the O&M Manual including table of contents, section tabs and scale mock-up of printing proposed. The Contractor will provide all the documentation required for the completed O&M Manuals before commencement of the start-up period. No payment for any work will be made over 90% of the Contract value until all documentation for the completed O&M Manuals are received and accepted as satisfactory. For the purpose of this Section, Contract Value will be equal to the Total Tender Price less applicable taxes and Contingency Allowance, plus approved Change Orders.

.3 In construction projects where work is carried out in distinct stages, the relevant portion of the manual will be required for that section of the work prior to equipment start-up. If completed documentation for this section of the work is not available, further payment will be withheld.

1.3.3 Contents

.1 Provide the material in volumes as described below. It is not necessary that each volume be in a separate binder. However, the arrangement must be approved by the Engineer. Where a binder is nearly full, the material of the next volume will be in a separate binder.

.1 Volume 1 – Operating Manual

.2 Volume 2 – Architectural/Structural Maintenance

.3 Volume 3 – Mechanical Operations and Maintenance

.4 Volume 4 – Electrical and Instrumentation Operations and Maintenance.

.1 Provide the following information for each system and major piece of equipment. Refer to each piece of equipment by its name and tag number. Where manufacturer's literature covers several models or options, highlight the applicable information and cross out redundant information.

.1 Index of information in that section in order of appearance.

.2 Description of system, components and technical data. Include interfaces, sequences, operations, characteristics changes for seasonal operation.

.3 Maintenance and operating instructions, including:

.1 Installation instructions

.2 Procedure for starting

.3 Proper adjustment

.4 Test procedures

.5 Procedure for operating

.6 Procedure for shutdown

.7 Safety precautions

.8 List of electrical relay settings and control and alarm contact settings.

.1 Troubleshooting data

.2 Preventative maintenance program complete with:

.3 Suggested check list sheets

.4 List of points to be greased or oiled

.5 Recommended type, grade and temperature range of lubricants

.6 List of wear points to be inspected and/or adjusted regularly

.7 Suggested schedule of lubrication and inspection

.9 Schematic, single line and wiring diagrams

.10 Valve tag list

.11 Recommended spare parts list

.12 Certification, guarantee, warranty

.13 Service representatives – name, address and telephone number

.14 Suppliers for replacement parts – name, address and telephone numbers

.15 Test results; witness testing and commissioning, reports

.16 Test data for piping systems (degreasing, flushing, disinfection)

.17 Hydrostatic or air tests performance

.18 Equipment alignment certificates

.19 Balancing data for air and water systems

.20 Inspection approval certificates for all types of systems; plumbing and piping, hot air and ventilating, electrical supervisory, etc.

1.3.4 The material submitted in accordance with the contractual requirements for "As-Constructed Shop Drawings" is generally bulky and difficult to file in a binder. If requested by the Engineer, provide copies of all "As-Constructed Shop Drawing" material in a single drawer legal size cardboard file cabinet. Arrange in accordance with the Construction Specifications Institute. Identify any material located in the file cabinet as such in the appropriate location in the binders.

1.3.5 At the Engineer's discretion, provide the information in plastic map pockets in appropriate sections in the binders.

.1 Binders

.1 Binders shall be large capacity, expanding/catalogue type for 11 x 8-1/2 sheets with expanding, lockable posts, 2" to 4", or 3" to 5" capacity, having fully hinged (metal, piano type) hard covers bound in heavyweight black fabricord with custom embossed gold lettering. Allow minimum 1/4" empty space inside each binder. Binders: ACCO 50505 05426, 50505 05436, or equal.

.2 The custom embossed gold lettering on the front cover and spine must include: the name of the Owner, Contract No., Contract Title, Owner Logo, "Operation & Maintenance Manual" title, Volume x of y number, Divisions included, and Set x of y number. Template for spine and cover page attached.

.3 Binder accessories – Sections will be separated with the divider pages with labelled printed indexes (side tabs) and reinforces with a rip-proof, three hold punched strip, or similar protection. Drawings will be folded and inserted in labelled clear plastic binder type pockets/sleeves (page protectors). CDs, DVDs, and other electronic media will be placed in labelled, clear plastic, static free binder type holder sheets.

.2 Provide one electronic pdf copy on CD-ROM and three individually bound hardcopies of completed Operations and Maintenance Manuals in accordance with Section 01700 – Contract Closeout.

1.4 Record Drawings and Samples

1.4.1 The Owner will supply a set of contract drawings. Mark thereon all revisions in red ink as the job progresses to produce a set of record drawings.

1.4.2 Dimension locations (vertically and horizontally) of buried or concealed work, especially piping and conduit, with reference to exposed structures. Dimension the installed locations of concealed service lines on the site or within the structure by reference from the centre line of the service to the structure column lines or other main finished faces or other structural point easily identified and located in the finished work.

1.4.3 Update these drawings and make available for monthly review. Payment against the Progress Payment line item for updated drawings will be withheld if drawings have not been maintained up-to-date.

1.4.4 Submit record drawings for electrical schematic and instrument control diagrams. Submit operation and maintenance instruction manuals with updated control diagrams, revised to show construction revisions.

1.4.5 Submit record drawings in SI metric units.

1.4.6 Record on the white prints on a daily basis, work constructed differently than shown on the Contract Documents. Record all changes in the work caused by site conditions, or originated by the Owner, the Engineer, the Contractor, or a sub-contractor and by addenda, supplemental drawings, site instructions, supplementary instructions, change orders, correspondence, and directions of regulatory authorities. Accurately record the location of concealed mechanical services and electrical main feeders, junction boxes and pull boxes. Do not conceal critical work until its location has been recorded.

1.4.7 Do not use these drawings for daily working purposes and make the set available for periodic inspection by the Engineer.

1.4.8 Make records in a neat and legibly printed manner with non-smudging medium.

1.4.9 The Contractor shall scan the complete set of “record drawing” mark-ups to PDF (full resolution) and upload progress “record drawing” sets onto the CIMA FTP site and transmit to the Engineer at the end of the project.

1.4.10 Submit all marked up record drawings to the Engineer at the conclusion of the contract. Substantial Performance will not be issued until record drawings are complete and submitted.

1.5 Recording Actual Site Conditions

1.5.1 Record information on set of drawing prints provided by the Engineer.

1.5.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

1.5.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

1.5.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances referenced to visible and accessible features of construction.

.4 Field changes of dimensions and details.

.5 Changes made by Contract Change Directives.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

1.5.5 Specifications: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and Contract Change Directives.

1.5.6 Other Documents: maintain manufacturers' certifications, inspection certifications, field test records, required by individual specifications sections.

1.6 Final Survey

1.6.1 The Contractor will be responsible for providing as-built survey elevations for all new work on the record drawings.

1.6.2 The Owner will check the 'As-Recorded' survey elevations.

1.7 Equipment and Systems

1.7.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

1.7.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications, final as-constructed diagram.

1.7.3 Include as-constructed installed colour coded wiring diagrams in the manual and also provide an electronic copy in AutoCAD.

1.7.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

1.7.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

1.7.6 Provide servicing and lubrication schedule, and list of lubricants required.

1.7.7 Include manufacturer's printed operation and maintenance instructions.

1.7.8 Include sequence of operation by controls manufacturer where appropriate.

1.7.9 Provide original manufacturers' parts list, illustrations, assembly drawings, and diagrams required for maintenance.

1.7.10 Provide installed control diagrams by controls manufacturer where appropriate. Include copies in the manuals and provide an electronic version in AutoCAD.

1.7.11 Provide coordination drawings, with installed colour coded piping diagrams.

1.7.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

1.7.13 Provide list of original manufacturers' spare parts, current prices, and recommended quantities to be maintained in storage.

1.7.14 Include test and balancing reports as specified in Section 01450 - Quality Control.

1.7.15 Additional requirements: As specified in individual specification sections.

1.8 Spare Parts

1.8.1 Provide spare parts, in quantities specified in individual specification sections.

1.8.2 Provide items of same manufacture and quality as items in Work.

1.8.3 Deliver to site location and place in storage as directed by the Owner.

1.8.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to Substantial Performance.

1.8.5 Where spare parts are not specified, provide the Engineer and Owner with a list of all spare parts recommended by the equipment manufacturer for all major pieces of equipment, valves, and instruments, including model or part numbers, and costs for individual items.

1.9 Maintenance Materials

1.9.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

1.9.2 Provide items of same manufacture and quality as items in Work.

1.9.3 Deliver to site location and place in storage as directed by the Owner.

1.9.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to Substantial Performance.

1.10 Storage Handling and Protection

1.10.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

1.10.2 Store in original and undamaged condition with manufacturers' seal and labels intact.

1.10.3 Store components subject to damage from weather in weatherproof enclosures.

1.10.4 Store paints and freezable materials in a heated and ventilated room.

1.10.5 Remove and replace damaged products at the Contractor's own expense and to the satisfaction of the Engineer.

1.10.6 Exercise all equipment in strict conformance with the equipment manufacturers written instructions during storage and following installation. Provide all equipment exercise logs to the Engineer for review.

1.11 Warranties and Bonds

1.11.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

1.11.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.11.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers.

1.11.4 No warranty will commence until issuance of Substantial Performance on respective work components. The warranty on items used during construction, with the Owner's permission, for the safe and orderly completion of the works will not commence until Substantial Performance.

1.11.5 Verify that documents are in proper form, contain full information, and are notarized.

1.11.6 Co-execute submittals when required.

1.11.7 Retain warranties and bonds until time specified for submittal.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 Testing is implemented to minimize commissioning time and to provide a smooth transition when bringing the system on-line.

1.1.2 The Contractor is responsible for coordinating the implementation and testing to ensure that the facility remains operational at all times.

1.2 General

1.2.1 The Contractor shall construct, test, commission and turn over to the Owner a complete operating facility.

1.2.2 The following requirements shall be met:

.1 All components shall be fully protected against damage prior to start-up. All temporary protection measures are the responsibility of the Contractor.

.2 The Contractor shall notify the Supplier(s) and the Engineer that the Project is ready for start-up testing and operation.

.3 The Contractor shall supply all labour and equipment for testing and commissioning.

.4 The Contractor shall provide a written Start-up and Commissioning Plan a minimum of 20 working days prior to the commencement of Start-up and Commissioning.

1.2.3 Testing and commissioning shall proceed as follows:

.1 Off-site system programming factory acceptance testing (FAT);

.2 Off-site control panel factory acceptance testing (Panel FAT);

.3 Off-site equipment factory acceptance testing (Equipment FAT);

.4 Complete start-up commissioning and performance testing of individual pieces of equipment and equipment sub-systems;

.5 On-site control system site acceptance testing (SAT);

.6 Continuous operation testing, as detailed within this document, demonstrating that the work of this contract has been commissioned in its entirety and that the Contract is substantially complete, and;

.7 Turn over the work to the Owner.

1.2.4 Testing and commissioning shall be performed by the Contractor in the presence of the Engineer and the Owner.

1.3 Quality Assurance Testing Program

1.3.1 The Contractor shall appoint an engineer or qualified operations specialist as Testing Manager to manage, coordinate and supervise the Contractor's Quality Assurance Program. The Testing Manager shall have at least 5 years' experience in managing start-up and commissioning of mechanical, electrical, instrumentation, HVAC and piping systems. The Contractor shall forward a copy of the Testing Manager's resume to the Engineer prior to the commencement of the testing program.

1.3.2 The Quality Assurance Testing Program for this project shall include:

.1 A calibration program for all instruments, gauges and meters used for determining the performance of equipment and systems installed under the Contract.

.2 A calibration program for all instruments, gauges and meters installed under the Contract.

.3 A testing program for all mechanical, electrical, instrumentation and HVAC equipment and process systems installed under the Contract. The testing program shall be divided into two phases: performance testing and operational testing.

.4 A comprehensive testing plan detailing the procedure of the testing program of all works required under this QA. The test plan shall include all equipment and process systems.

.5 The test plan shall include procedures for the evaluation of the performance of the equipment and process system, including the required specified performance criteria.

.6 A schedule providing date, time, sequence and duration of the performance and operational testing for each equipment and process system. The Critical Path Method shall be used for the scheduling of the test plan and shall be updated as required to reflect changes.

.7 A documentation program to record the results of all equipment and system tests.

1.3.3 All test equipment, gauges, thermometers, meters, analysis instruments and other equipment used for calibrating or verifying the performance of equipment installed under this Contract shall be calibrated to within ± 2% of actual value at full scale. Test equipment employed for individual test runs shall be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 85 percent of full scale.

1.3.4 Pressure gauges shall be calibrated in accordance with ANSI/ASME B40.1.

1.3.5 Thermometers shall be calibrated in accordance with ASTM E77 and shall be furnished with a calibration curve.

1.3.6 Liquid flowmeters installed in pipelines with diameters greater than 50mm shall be calibrated in-situ using the pitot tube velocity averaging method. Calibration tests for flow metering systems shall be performed over a range of not less than 10% to at least 75% of system full scale. At least five confirmed valid data points shall be obtained within this range. Confirmed data points shall be validated by not less than three (3) test runs with results which are in agreement within ± 2%.

1.3.7 The following documents referred to in this Quality Assurance Program take precedence over requirements that may be listed in other parts of the Contract. In case of a conflict between

the requirements of this QA Program and that of the Contract Document, the QA Program shall take precedence:

.1 ANSI/ASME B40.1 Gauges Pressure Indicating Dial Type – Elastic Element

.2 ASTM E77 Method for Verification and Calibration of Liquid-in-Glass Thermometers

.3 ASHRAE 41.8 Standard Methods of Measurement of Flow of Gas

.4 Flow Measurement in Sewer Lines by The Dye Dilution Method, Journal of the Water Pollution Control Federation, Vo. 55, Number 5, May 1983, pg. 531.

.5 Flow Measurement in Open Channels and Closed Conduits, Vo. 1, US Dept. of Commerce, National Bureau of Standards, pg. 361

.6 Techniques of Water Resources Investigation of the US Geological Survey, Chapter 16, Measurements of Discharge Using Tracers

.7 Other standards as applicable

.8 If the above listed standards are revised, the most recent version will be applicable

1.4 Submittals

1.4.1 Submittal material shall consist of the following:

.1 Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by the Contractor for the systematic testing of all equipment and systems installed under this contract.

.2 Sample test acceptance forms for documenting the results of testing, for each test to be performed, that shall be submitted as Shop Drawings as per these specifications.

.3 The credentials and certification of the testing laboratory proposed by the Contractor for calibration of all test equipment.

.4 A testing and commissioning schedule.

.5 Test forms documenting the results of testing and commissioning completed to the satisfaction of the Engineer.

1.5 Definitions

1.5.1 Pre-Start-Up: Pre-start-up consists of the non-operating functions required to bring Work to a state of readiness for placing systems into service. It includes, but is not limited to; cleaning, leakage and pressure testing, cold alignment checks, disinfection, system flushing, lubrication of mechanical equipment, rotation checks and wiring loop checks. Contractor to conduct inspections of all components and sub-components and will arrange for inspections of equipment installations by qualified equipment manufacturers' representatives as required by Contract Documents. At this stage, deficiency lists are prepared, and Contractor is to remedy outstanding incomplete or incorrect work in accordance with terms of Contract. Contractor will obtain completed Equipment Installation Certification Forms for each specified piece of equipment and will submit these to Engineer for review. A Pre-Start Health and Safety Review will be performed for each piece of equipment. Once Engineer is satisfied that

each piece of equipment in a system or subsystem has been properly checked out and all apparent deficiencies have been remedied, a Green “Ready-to-Start” tag will be placed on the equipment designating that the Pre-Start-Up Phase for that particular system is complete.

1.5.2 Start-Up: Once each piece of equipment within a defined system carries a “Ready-to-Start” tag, then that individual system will be started and tested locally. Both “Dry-Run” and “Wet-Run” tests are required. Contractor will conduct performance tests of all equipment in conjunction with the manufacturers’ representatives as required by the Contract Documents and under the witness of Engineer. Deficiencies that are uncovered will be corrected and retesting will be conducted as required. Start-Up Completion Certificates will be prepared by Contractor certifying that the equipment or system is complete, successfully tested, started and ready for commissioning and continuous operation.

1.5.3 Commissioning: Commissioning consists of placing all the various systems in Works into automatic and continuous operation in an orderly manner. The Contractor is responsible for the commissioning activities and will have equipment manufacturer representatives at the site, as well as qualified mechanical, electrical, control and instrumentation personnel. Contractor may be assisted by Engineer relative to process considerations and by Owner’s operations and maintenance staff. Commissioning is considered to be complete when all systems have been operating for a set period of time without fault and in accordance with the specified performance requirements.

1.6 Pre-Start-Up

1.6.1 Prepare Pre-start-up Equipment Checkout List, which includes all Process Mechanical, Commodity-retaining Structures, Building Mechanical, Instrumentation and Controls and Electrical Equipment. Group list into logical systems or sub-systems for orderly progression of activities during start-up.

1.6.2 Identify all pieces of equipment by Tag Numbers.

1.6.3 Conduct disinfection procedures in accordance with requirements of individual Sections.

1.6.4 Provide Checkout Tag for each piece of equipment.

1.6.5 Checkout Tags to be filled in by each applicable trade verifying that all appropriate checks have been made, including but not limited to, cleaning, inspection, leakage testing, lubrication, rotation, calibration, adjustment and wire loop checks.

1.6.6 Equipment Manufacturer’s Representatives to inspect equipment in accordance with applicable individual Sections. Certify equipment has been properly installed and is ready to start.

1.6.7 Contractor to submit Equipment Checkout Listing to Engineer. Equipment Checkout Listing to include the following:

.1 System description.

.2 Equipment Name and Tag Number of each component within System.

.3 Supplier’s Name of each equipment component, complete with sign-off where applicable.

.4 Mechanical Trade sign-off (Blue and White Cards completed).

.5 Electrical/Instrumentation Trades sign-off (Red, Yellow and White Cards completed).

.6 Contractor sign-off (all cards completed).

1.6.8 Attach the following to Equipment Checkout Listing:

.1 Manufacturer's Representatives' Installation Certification Form.

.2 Hydrostatic Test Certification Forms for Process Tanks.

.3 Pressure Test Certification Forms for Process Tanks.

.4 Disinfection Certification Forms where applicable.

.5 Instrumentation and Electrical Equipment Loop Check Forms.

.6 Instrumentation Calibration Forms.

.7 Listing of outstanding contract deficiencies for each system.

1.6.9 Conduct a "Pre-Start Health and Safety Review" as detailed in Clause 1.7 below.

1.6.10 Request, in writing, a Pre-Start-Up Inspection by Engineer. Once Engineer has conducted the Pre-Start-Up Inspection and is satisfied that each piece of equipment has been properly checked-out, a green "Ready-to-Start" tag will be attached to each piece of equipment in the system.

1.7 Pre-Start Health and Safety Review

1.7.1 The Contractor shall ensure that a Pre-Start Health and Safety Review of all installations and constructions in the Contract, as required, is completed prior to the issuance of, and as a condition of, Substantial Completion.

1.7.2 The review shall be conducted as required by and specified in the [Industrial Ontario Regulations for Industrial Establishments, O. Reg. 851, Section 7, using as a reference the Guidelines for Pre-Start Health and Safety Reviews: Application of Section 7 of the Regulation for Industrial Establishments, 851/90 (Revised Regulations of Ontario).

1.7.3 Without limiting the requirements of the Regulation, the final deliverable shall be a Pre-Start Health and Safety Review Report, dated and sealed by a Professional Engineer licensed in the Province of Ontario. This report shall describe measures to be taken to bring the Works into compliance with the applicable provisions of the Regulations for Industrial Establishments.

1.7.4 Total price for this service shall include all reports and follow-up inspections, as required.

1.8 Start-Up

1.8.1 Conduct workshop with Owner's Representatives and Engineer to identify and integrate activities of all parties in start- up of Work. Prepare Start- up Plan which includes the following:

.1 Plan objectives.

.2 Facilities/Items to be started.

.3 Sequence of events and start-up schedule.

.4 Responsibilities of each party.

.5 List of individuals involved complete with contact telephone numbers.

.6 English language description of each system's intended means of operation.

.7 Initial operating conditions and parameters.

.8 Intended final operating conditions and parameters.

.9 Laboratory requirements and arrangements for outside testing services.

.10 Sampling and monitoring requirements.

.11 Contingency plans to respond to potential emergencies.

.12 Safety and environmental considerations.

1.8.2 Develop Owner Training plan and implement.

1.8.3 Provide Operating and Maintenance Manuals as required by individual Sections.

1.8.4 Conduct Dry Run Tests for all equipment and pre-selected systems for a specified period of time, witnessed by Engineer.

1.8.5 Conduct Wet Run Tests for all equipment and pre-selected systems for a specified period of time, witnessed by Engineer.

1.8.6 Correct any deficiencies uncovered during testing.

1.8.7 Provide Pre-Commissioning Certification Form.

1.9 Commissioning

1.9.1 Assemble commissioning team to assist with commissioning. Team to consist of representatives of Contractor and Contractor's mechanical, electrical and instrumentation staff, equipment suppliers, and subcontractors, as appropriate.

1.9.2 Contractor's process / facility operation representative in charge shall be on site during entire commissioning period.

1.9.3 The other members of the commissioning team be at site as specified under other specifications and during normal working hours for the entire commissioning process. The Contractor's representative and the commissioning team may be required to be at site outside of normal working hours during the commissioning period, at the discretion of Owner or Engineer and shall be available within four hours' notice.

1.9.4 During the commissioning all systems to operate without fault and all process, mechanical, control and electrical equipment free of vibration, overloading or overheating and functioning in accordance with specified rates, methods and performance.

1.9.5 Commissioning to be generally conducted in manual mode first, followed by automatic operation. The total operation in manual mode during commissioning shall not exceed 10% of total commissioning time.

1.9.6 Remove and clean or replace as required all permanent and temporary filters and strainers in pipeline systems; dewater, clean, and leave process systems clean, unless otherwise directed by Engineer.

1.9.7 Contractor to commission Work in stages based on the agreed commissioning packages. Each commissioning package to consist of fully functional portions or groups of operationally tested systems capable of operating in concert to provide a complete service or function that is of value to Owner.

1.9.8 Failure of any part of Work during the period of continuous operation will require restart of that portion or system of Work, following rectification of the fault or failure.

1.9.9 If it is necessary to suspend start-up, commissioning or continuous operation during the commissioning period due to deficiencies or failure in any system, the full cost of interruption, call-back, testing and resumption of start-up, commissioning, or continuous operation will be paid by Contractor. Correct deficiencies revealed during initial operation. Correct and adjust equipment operation.

1.10 Continuous Operation Test

1.10.1 Once equipment and/or systems have been tested individually, the Contractor shall complete a continuous operation test. This test shall be continuous for a minimum fourteen (14) day period and shall demonstrate that the work identified in this contract is substantively complete.

1.10.2 The (14) fourteen-day continuous operation period shall be performed at both the Scane and Colby Site respectively.

1.10.3 The continuous test will be considered failed in the event that an interruption exceeds one hour. Interruption required for fine-tuning instruments lasting less than one hour will be considered minor interruptions. A total of three minor interruptions will be permitted each day.

1.10.4 Subsequent to the continuous operation test and prior to the award of substantial performance, the Contractor shall co-ordinate a deficiency inspection, to be attended by the Owner, Engineer and Contractor. The purpose of this inspection shall be to establish the contract deficiency list.

2 PRODUCTS

2.1 Documentation

2.1.1 The Contractor shall develop and implement a record keeping system to document compliance with the requirements of this Section.

2.1.2 Test acceptance forms as a minimum shall include date of test, equipment number or system name, nature of test (performance or operational), test objectives, test results, test instruments employed for the test and signature spaces for the Engineer's witness and the Contractor's Testing Manager. A file shall be established for each system and item of equipment. It is suggested that files be maintained separately for pipe pressure testing, mechanical equipment performance testing, instrumentation equipment performance testing (loops), and electrical equipment.

2.1.3 It shall be the requirement of this Contract that the Contractor shall develop test documentation forms specific for each system and associated equipment items installed under this Contract. Acceptable documentation forms for all systems and items of equipment shall be produced for review by the Engineer a minimum of four weeks prior to any performance testing. Once the Engineer has reviewed and taken no exception to the forms proposed by the Contractor, the Contractor shall produce sufficient forms, at his expense, to provide documentation of all testing work to be conducted as a part of this Contract.

2.1.4 The Contractor shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this contract. The test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors' and manufacturers' representatives to be present and expected test duration. The test plans shall include the following features:

.1 FAT(s);

.2 Panel FAT(s);

.3 Equipment FAT(s);

.4 Performance testing including but not limited to:

.1 Pressure and/or leak tests.

.2 Functional checkout of all electrical tests.

.3 Electrical circuit ringouts.

.4 Resistance tests of all electrical equipment and electrical systems.

.5 Instrument calibration, loop test, loop commissioning and tuning.

.6 Preoperational check out for all mechanical and HVAC equipment.

.7 Functional tests of all mechanical, electrical, HVAC and instrumentation equipment and systems to demonstrate compliance with the performance requirements.

.8 Control network testing.

.5 In general, performance tests for any individual system shall be performed in the order listed above. The order may be altered as authorized by the Engineer in writing after receipt of a written request, complete with justification of the need for the change in sequence.

.6 SAT(s);

.7 Continuous performance test.

2.1.5 Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment.

2.1.6 Four weeks in advance of the date the Contractor wishes to begin performance testing of equipment and/or systems (whichever occurs earliest in the project schedule), the Contractor shall have submitted the test plan(s) required for the systematic field performance tests for the equipment and/or system installed under this contract. Once the Engineer has reviewed and taken no exception to the Contractor's test plan(s), the Contractor shall reproduce the plan(s) in sufficient number for the Contractor's purposes and an additional three copies for delivery to the Engineer. No test work for the equipment, system or facility shall begin until the Contractor has delivered the specified number of approved final test plans to the Engineer.

2.1.7 The Contractor shall produce a testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be in bar chart form, plotted against calendar time, and shall detail the equipment and/or systems to be tested. The schedule shall show the contemplated start date, duration of the test and completion of each test. The test schedule shall be submitted no later than four weeks in advance of the date testing is to begin. The Engineer will not witness any testing work for the purpose of acceptance until the Contractor has submitted a schedule to which the Engineer takes no exception. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily.

2.2 Equipment and System Performance Tests

2.2.1 Each item of process, mechanical, electrical, instrumentation, and HVAC equipment installed under this contract shall be tested to demonstrate compliance with the performance requirements of this project manual. Each electrical, instrumentation, mechanical, piping, and HVAC system installed or modified under this contract shall be tested in accordance with the specified requirements.

3 EXECUTION

3.1 Testing

3.1.1 The completed works shall be subject to testing and trial operation to determine whether works function as required for the intended purpose. The Contractor shall give the Engineer at least four days prior notice of the testing program. The Contractor shall conduct tests only in the presence of the Engineer or Engineer's appointed representative and under his general direction. The Contractor shall provide all equipment, gauges, materials, water and labour required to conduct the tests.

3.1.2 Testing and commissioning shall be completed in accordance with the manufacturer’s recommendations and the Contract Documents.

3.1.3 Test results shall be within the tolerances set forth in the detailed specification sections. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory installed test, any doubt, dispute, or difference should arise between the Engineer and the Contractor regarding the test results or the methods or equipment used in the performance of such test, and then the Engineer may order the test to be repeated.

3.1.4 If under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the work as are affected thereby, shall, unless otherwise directed by the Engineer, be repeated within reasonable time and in accordance with the specified conditions. The Contractor shall pay to the Owner all reasonable expenses incurred by the Owner, as a result of repeating such tests.

3.2 Continuous Operation Test and System Handover

3.2.1 The Contractor shall co-ordinate the continuous operation test with the Engineer and Owner.

3.2.2 The test shall be either live (i.e. supplying treated effluent water to the system/handling wastewater or off-line in recirculation mode or discharge-to-waste mode. The Owner will dictate whether the test shall be live or off-line, based on system demands and the need to keep the system in-service.

.1 For live testing, the Contractor shall ensure that the system has been properly disinfected or cleaned, as applicable.

.2 For off-line testing, the Contractor shall install temporary connections, bulk heads, and other provisions as required to effect the testing and simulate anticipated operating conditions.

3.2.3 The Contractor shall provide continuous site supervision for the duration of this test.

3.2.4 During this test, the Contractor's Testing Manager and testing team shall monitor the characteristics of each piece of equipment, instrumentation and each control device according to the Manufacturer's specifications and report any unusual conditions to the Engineer.

3.2.5 Should the Engineer deem that the test needs to be stopped as a result of the non-performance of any work completed under this Contract, the Contractor shall make good the non-performing component and restart the test at time zero. Should the Engineer or Owner stop the test for any other reason, the test will be restarted and run for the remaining balance of this period.

3.3 Continuous Performance Test

3.3.1 Once equipment and/or systems have been tested individually, the Contractor shall complete a continuous performance test. This test shall be continuous for a minimum 14-day calendar period and shall demonstrate that the work identified in this contract is substantively complete and operating as intended.

3.3.2 The performance test shall not start on a Monday or Friday.

3.3.3 The continuous test will be considered failed in the event that an interruption exceeds one hour. Interruption required for fine-tuning instruments lasting less than one hour will be considered minor interruptions. A total of three minor interruptions will be permitted each day.

3.3.4 Should the Engineer deem that the test needs to be stopped as a result of the non-performance of any work completed under this Contract, the Contractor shall make good the non-performing component and restart the test at time zero. Should the Engineer or Owner stop the test for any other reason, the test will be restarted and run for the remaining balance of this period.

3.3.5 During the period of continuous performance testing, the Contractor shall coordinate, mechanics, electricians, and other maintenance personnel to attend to any adjustments, corrections or operations which may be required.

3.3.6 Subsequent to the continuous performance test and prior to the award of substantial performance, the Contractor shall co-ordinate a deficiency inspection, to be attended by the Owner, Engineer and Contractor. The purpose of this inspection shall be to establish the list of remaining deficiencies or uncompleted works and their respective value.

3.4 Test Forms

3.4.1 It is a condition of acceptance for commissioning by the Owner that all equipment test forms be signed by the Contractor, Engineer, and the Owner indicating acceptance.

3.4.2 Prepare all test forms for use in advance of system performance and operational testing.

3.5 Equipment and System Performance Tests

3.5.1 Each item of process, mechanical, electrical, and instrumentation equipment installed under this contract shall be tested to demonstrate compliance with the performance requirements of this project manual. Each electrical, instrumentation, mechanical, and piping system installed or modified under this contract shall be tested in accordance with the specified requirements.

3.6 Cleaning

3.6.1 Following completion of the continuous operational testing period, the Contractor shall replace all HVAC filters; dewater and clean all sumps; dewater all process units for the deficiency inspection, and other tasks as required to return the installation to an as new condition. The system shall be completely cleaned to the satisfaction of the Engineer and the Owner prior to turning over to the Owner.

3.7 Utilities and Consumables

3.7.1 The Contractor is required to provide and pay for all services, water, electricity and any other temporary services required during the construction and commissioning period. The Owner shall pay for all electricity costs following the date of commencement of operation of the Northwest Quadrant HLPS Facility.

3.7.2 Prior to the commencement of operation and at the end of the start-up operation period the Contractor shall ensure that all the equipment has been thoroughly greased and oiled with materials approved by the manufacturer and in accordance with the manufacturer's written instructions.

3.7.3 At the end of the start-up operation period, all manuals, parts and supplies which are required by the Contract shall be turned over to the Owner.

3.7.4 During the period of operation, the Contractor shall have at the site supervisory personnel, mechanics, electricians, and other maintenance personnel to attend to any adjustments, corrections or operations which may be required.

3.7.5 Before the Owner takes over the station from the Contractor or issues the Certificate of Substantial Performance, the Contractor's period of operation shall have been successfully

completed and the certificates required by the Contract Documents shall have been submitted.

3.8 Documentation

3.8.1 It is a condition of acceptance for commissioning by the Owner that all equipment test forms be signed by the Contractor, Engineer, and the Owner indicating acceptance.

3.8.2 At the end of the continuous performance test period, all manuals, parts and supplies which are required by the Contract shall be turned over to the Owner.

3.8.3 Before the Owner takes over the station from the Contractor or issues the Certificate of Substantial Performance, the Contractor's period of operation shall have been successfully completed and the certificates required by the Contract Documents shall have been submitted.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section describes requirements for demonstration, training and instruction in the operation and maintenance of equipment and systems to the Owner and plant personnel.

1.2 Quality Assurance

1.2.1 Demonstrate operation and scheduled maintenance of equipment and systems to the Owner and plant personnel as outlined in this section.

1.2.2 The Owner will provide a list of personnel to receive instructions.

1.2.3 The Owner will pay the Owner's staff and plant operating staff for all costs associated with demonstrations and training, including time, travel, lodgings, etc. The Owner reserves the right to deduct the cost of any cancellations or repeat sessions necessary as a result of the Contractor's actions from any monies due to the Contractor under this Contract.

1.3 Quality Control

1.3.1 Submit qualifications and experience of all specialists who will be conducting demonstrations and training for the approval of the Engineer 15 working days in advance of the planned start date. All personnel must be suitably qualified and experienced in the respective type and models of equipment being used.

1.4 Submittals and Schedule

1.4.1 Submit outline of all demonstration and training sessions 15 working days in advance of the planned start date.

1.4.2 Submit schedule of time and date for all demonstration and training sessions 15 working days prior to the planned start dates for the Engineer's approval.

1.4.3 Maintain a record of all attendees for demonstration and training sessions and submit to the Engineer, along with a report on all sessions prior to Substantial Performance.

1.4.4 Allow sufficient time in the construction schedule and test plan for completion of demonstration and training.

1.4.5 Coordinate attendance of demonstration and training specialists with availability of Owner and plant personnel.

1.4.6 Where the same personnel are used for testing and commissioning and for demonstration and training, ensure that the testing and commissioning work is completed to the satisfaction of the Engineer before the demonstration and training commences and that sufficient time is set aside to complete the demonstration and training.

1.4.7 All factory training programs, if required, shall be completed prior to start of testing and commissioning and use equipment similar to that being supplied.

1.4.8 All classroom training programs, if required, shall be completed prior to the start of testing and commissioning.

1.4.9 All training shall be completed prior to Substantial Performance. Feedback training sessions may be required at a later date.

1.4.10 All field training programs shall be fully co-ordinated with construction, testing and commissioning. Where projects are phased, training for each phase shall be completed before acceptance of that work. Separate training sessions shall be conducted for each phase as required. Separate training sessions may be required as a result of shift work by operations staff, customize to suit.

1.4.11 All training sessions will be conducted Monday to Friday between 8 a.m. to 3 p.m.

1.5 Pre-Conditions for Demonstrations and Training

1.5.1 Where appropriate, components shall be pre-commissioned and ready for final testing and commissioning. Equipment and Instruments shall be capable of operating as intended, during demonstration and training sessions.

1.5.2 Training materials will be approved by the Engineer and available to trainees.

1.6 Training Materials

1.6.1 Course Materials:

.1 Provide sufficient written materials to support all demonstration and training sessions.

.2 All materials provided for training shall conform to the following:

.1 Size:8.5 x 11 inches

.2 Paper: 20-lb minimum, white, for typed pages

.3 Text: Manufacturer's printed data, or neatly word processed, the designed specifically for leaning. Ample space for note-taking shall be provided.

.4 Double-sided.

.5 Drawings and Sketches:

.1 Provide reinforced punched binder tab, bind in with text.

.2 Reduce larger drawings to not larger than 11 x 17 inches and fold to size of text pages.

.3 Use colour prints to highlight key elements.

1.6.2 Cover to include:

.1 Contract number

.2 Title of project

.3 Identity of separate structure or system as applicable.

.4 Identity of general subject matter covered in the manual.

.5 Locations or facility names.

.6 Publication date.

.7 Revision number.

1.6.3 Binders shall be:

.1 Commercial quality D-ring binders with durable and cleanable plastic covers.

.2 Maximum post width: 2 inches.

.3 When multiple binders are used, the contractor shall correlate the information into related consistent groupings and clearly number all volumes.

1.6.4 Recordings:

.1 The use of standard recorded materials for training will be considered provided they are professionally produced, reviewed and approved by the Owner prior to use. Recording shall be in digital format and shall become the property of the Owner.

.2 The use of this material shall be viewed as an enhancement to the required face-to-face training and not a substitute.

.3 The Owner reserves the right to record all training sessions.

1.7 Required Demonstration and Training Sessions

1.7.1 Provide sufficient demonstration to cover start-up, operation, control, adjustment, calibration, troubleshooting, servicing, maintenance and shut down of all components of the works.

1.7.2 Allow for training six personnel in each of two separate sessions at least two working days apart.

1.7.3 Provide the following demonstration and training sessions as a minimum requirement:

Item No.	Session Title	Minimum Hrs Per Session
1	Low Lift Pumps and VFDs	8
2	Manual Screens	8
3	Sodium Hypochlorite System	8
4	Intake and Air Backwash System / Raw Water Sampling Pump / Intake Screen/Structure & intake cleaning	12
5	Process Valves and Sluice Gates	4

Item No.	Session Title	Minimum Hrs Per Session
6	Electric Actuators and Instruments	4
7	Instrumentation (LITs, PITs, FMs, analyzers)	12
8	Controls System (SCADA)	12
9	Traveling cranes	4
10	HVAC System	4

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

END OF SECTION

DIVISION 2 – SITEWORKS

Section No.	Title
02137	Bracing and Shoring
02140	Dewatering
02150	Turbidity Curtain
02151	Light Duty Silt Fence Barrier
02152	Straw Bale Flow Check Dams
02231	Close-Cut Clearing and Grubbing
02311	Site Grading and Access
02315	Excavation, Trenching and Backfilling
02362	Dust Control
02480	Installation of Pipeline by Horizontal Directional Drilling
02481	Installation of Pipeline by Earth and Rock Trenching
02511	Watermains
02530	Sanitary Service Connection, Appurtenances & Cleanout
02532	Subdrains
02540	Extruded Expanded Polystyrene Insulation
02725	Hot Mix Asphalt Paving
02726	Asphalt Pavement Removal
02911	Topsoil and Sod

1 GENERAL

1.1 Scope

1.1.1 This specification covers the requirements for the design, supply, placement, maintenance, and removal or abandonment of temporary support systems required to permit the excavation and backfilling of trenches or excavations for the installation of underground utilities and any other specified subsurface construction.

1.1.2 This specification also covers the requirements for the design, placement, maintenance, and removal or abandonment of temporary support systems required to permit the construction of below grade structures and/or foundations for building structures.

1.1.3 Shoring is mandatory where indicated and, in all areas, where excavation will potentially undermine existing structures, pipes, conduits, utilities or roadways.

1.1.4 Subject to paragraph 1.1.3, it will be the Contractor's decision whether to carry out general excavation in open cut or to use shoring system to conserve space and/or control groundwater infiltration.

1.2 Related Sections

1.2.1 DIVISION 1 – GENERAL REQUIREMENTS

1.2.2 Section 02140 – Dewatering

1.2.3 Section 02315 – Excavating, Trenching and Backfilling

1.3 References

1.3.1 Occupational Health and Safety Act, R.S.O. 1990, c.O.1, as amended.

1.3.2 Ontario Regulation 213/91 – Regulations for Construction Projects, as amended.

1.3.3 OPSS 404 – Construction Specification for Support Systems.

1.3.1 CSA A23.1/A32.2-24 - Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete

1.3.2 CSA G40.20-13/G40.21-13 (R2023) - General requirements for rolled or welded structural quality steel / Structural quality steel.

1.3.3 CSA W59-24 – Welded Steel Construction

1.4 Measurement and Payment

1.4.1 Measurement and **P**ayment shall be according to Section 01025.

1.5 Design of Shoring System

1.5.1 Design excavation shoring and/or underpinning systems based on recognized geotechnical and structural theories and principles and site conditions encountered. Undertake additional

geotechnical site investigation for design of the shoring system and/or underpinning at no extra cost to the Owner.

1.5.2 Design shoring system for all applicable lateral pressures from soil and groundwater, including unsymmetrical surcharge loads from construction operations and frost action on retained soil.

1.5.3 Design shoring system such that intermediate bracing members, walers or struts will not interfere with the permanent structure. All below grade structures are to be complete with ground level slabs, and other bracing elements prior to backfill.

1.5.4 Design bracing to be fully effective at all stages of construction. Pre-stress bracing, if required, to control deflection.

1.5.5 Design underpinning and temporary supports for existing structures and/or utilities to safely resist all loads including loads which may be imposed as a result of construction operations.

1.5.6 Where shoring system retains materials which provide support for foundations at a higher level, design to limit deflections so that foundation materials are not disturbed or weakened. Design lateral pressures to be determined based on at-rest soil pressures. Limit total deflection to 20 mm horizontally.

1.5.7 Co-ordinate design of shoring system with design of dewatering system to meet performance requirements specified herein.

1.5.8 Locate all yard piping, services, conduit, structures, etc., in the area of the excavation. Assume all items found are live and are to be kept live unless specifically noted otherwise. Take precautions necessary to ensure that there is no damage to existing buried services, piping, conduit, structure, etc., during the shoring and excavation work.

1.6 Method Statement

1.6.1 Submit method statements for the construction sequence and duration of all main activities including any ground treatment that may be required to construct without the use of active dewatering at least fifteen (15) days prior to the commencement of the Works.

1.7 Shoring Performance Requirements

1.7.1 General Requirements

.1 Construct substantially watertight excavation shoring systems suitable for geotechnical conditions encountered and which will meet all requirements of these performance Specifications. Prevent destabilization of subgrade, migration of soil fines, damage to any structure and/or works. Prevent disturbance, displacement or damage, to sides and bottom of excavation, to new and existing structures, pipelines, utilities, roads, embankments, etc. at any stage of construction of works. Prevent destabilization or failure of bottom of excavation from shear, heave, piping and boiling, groundwater pressure or any other cause.

.2 Review Utilities drawings and Site Survey, available from the Engineer showing site information and configuration of existing buildings and services.

.3 Prior to beginning work on the site, confirm location of all underground services and structures, and arrange work to prevent damage to any services or structures.

.4 Provide adequate space for access for installation of formwork and inspection.

1.7.2 Watertightness

.1 Shoring system to be watertight to the extent that any dewatering required inside the excavation shall not lower the water table on outer side of the shoring system.

1.7.3 Tolerances

.1 Install shoring so that, exclusive of temporary walers or bracings, no part of temporary structure to be left in place above the bottom of the excavation in its deflected position will reduce the concrete wall thicknesses to below the dimensions indicated.

.2 If the shoring installation does not satisfy these requirements, alter it, at no extra cost to Owner, until it meets the requirements.

.3 Allow a minimum installation tolerance of 75 mm.

.4 Fill the void between any shoring to be left in place and the adjacent structural member with concrete.

1.7.4 Monitoring Deflection

.1 The contractor shall hire a monitoring contractor with at least five years' experience in precision survey monitoring that can demonstrate having performed at least 10 projects of similar scope, magnitude and complexity to develop and execute a precision survey program for monitoring movement at the top of the shoring wall. The system shall achieve an accuracy of plus/minus 2 mm at each measurement point.

.2 The monitoring contractor is responsible for developing the system to meet 2 mm accuracy but the system at a minimum meet the following criteria:

.1 Monitoring points are to be spaced no more than 3 m apart and at all critical locations.
.2 Movement in the x, y and z direction must be measured at each point.
.3 The surveying instrument shall be a Leica TCA 1800 or equal. The manufacturer's published accuracy must be at least one second angular resolution with plus minus 1 mm electronic distance measurement at 100 m distance.

.3 Readings shall be recorded twice weekly until the excavation is no longer open.

.4 Reports shall show movement in both at a tabulated and graphical format. The owner's representative to approve the reporting format prior to start of the work.

.5 Data is to be reported weekly, but immediately if any unusual movements occur.

.6 Monitor and control vibration in accordance with Specification Section 01140 – Special Project Procedures.

1.8 Submittals

1.8.1 Submit shop drawings at least fifteen (15) days before commencement of shoring Works for temporary structures including both shoring and bracing systems. Shop drawing to bear seal

and signature of a Professional Engineer, registered in the Province of Ontario, who has carried out the design and who will provide construction supervision of temporary structures.

1.8.2 Indicate on shop drawings the following:

.1 Dimensions and elevations

.2 Relationship to new and existing structures and utilities

.3 Material designations, grades, sizes, etc.

.4 Temporary struts and walers etc., their relationship to permanent structure and schedule for removal

.5 Permanent tie backs locations, size and embedment.

.6 Deflections of shoring members when deflection limitations carried in the design.

.7 Design loads, design assumptions, surcharge loads and all loading restrictions.

.8 Identification of Engineer of record who will be responsible for design calculations, checking of shop drawings, inspection and supervision of fabrication and installation, and filing of reports with the appropriate authorities and the Owner.

.9 Complete field instructions required during installation and any other pertinent information.

.10 Schedule for removal of temporary struts and walers.

.11 Preparation method to be used on shoring prior to application of blindside waterproofing if indicated in the drawings.

1.8.3 Submittal of shop drawings for such temporary structures is for record purposes. The Engineer will not review or check such shop drawings for structural adequacy. Take the full responsibility for design, supplying, placing installation and maintenance.

1.8.4 Prior to commencing excavation in any area protected by temporary shoring, the Engineer of Record shall provide written certification that the shoring has been constructed in accordance with the approved drawings as amended by field instruction. This submittal will not apply to trench boxes.

1.8.5 Submit all monitoring of deflection, vibration, settlements of shoring and adjacent structures weekly.

1.9 Quality Control

1.9.1 Provide a system of quality control to ensure that the minimum standards specified herein are attained.

1.9.2 Bring to the attention of Engineer any defects in the work or departures from the Contract Documents which may occur during construction. The Engineer will decide upon corrective action and state recommendations in writing.

1.9.3 The Engineer's general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to the Engineer are both undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve him of contractual responsibility.

1.10 Quality Assurance

1.10.1 Engage a Professional Engineer, licensed in Ontario, to design, supervise installation of, and inspect all temporary structures for the duration of construction.

1.10.2 Utilize only personnel with demonstrated competence and experience to install temporary structures.

1.10.3 Welder: CSA W47.1 certified.

2 PRODUCTS

2.1 Materials

2.1.1 Steel Liner Plates

.1 Corrugated proprietary steel liner plates with bolted joints and grouting nipples supplied on a sufficient number of plates to provide grouting connections at 3 m maximum around the circumference and every second ring of plates.

2.1.2 Structural Steel Members

.1 CAN/CSA G40.20/G40.21 Grade 300W for walers, bracing and soldiers piles.

2.1.3 Welding

.1 CSA W59 Welded Steel Construction

2.1.4 Steel Sheet Piling:

.1 Per CAN/CSA G40.20/G40.21 interlocking type. Selection properties to suit design.

2.1.5 Lumber

.1 Graded lumber, sound, straight, free from cracks, shakes, large or loose knots. Use planks for sheeting, tongued and grooved, or grooved and splined as required.

2.1.6 Drypack Concrete Fill Behind Lagging

.1 Concrete in accordance with Section 03300 suitable for filling all voids behind lagging with a 28-day minimum compressive strength of 20 MPa.

2.1.7 Concrete Mixes and materials

.1 In accordance with CSA A23.1/A23.2

3 EXECUTION

3.1 General

3.1.1 Before work begins, inspect conditions upon which work depends. Inform the Engineer, in writing, of conditions not identified.

3.1.2 Protect adjacent structures, utilities, pipelines, or other foundations on or below grade from damage and/or displacement.

3.1.3 Monitor and control vibration of existing structures in accordance with Section 01140 – Special Project Procedures.

3.1.4 Co-ordinate requirements of shoring system with Section 02140 - Dewatering.

3.2 Cold Weather Protection

3.2.1 Between the 15th of October of any year and the 15th of April of the following year, provide on hand and ready for use all equipment necessary for adequate cold weather protection.

3.2.2 Provide sufficient insulation, and heat as necessary, to prevent freezing of frost susceptible soil behind temporary shoring works.

3.2.3 When providing heat, do not dry out sensitive soils such as clays.

3.3 Responsibility for Shoring System

3.3.1 Retain the services of a professional engineer, registered in the Province of Ontario, who has demonstrated competence in shoring and underpinning work, to design and supervise construction of temporary structures which are required in order to execute construction of permanent Works.

3.3.2 Take full responsibility for design, supply, placement, installation, maintenance, and where applicable, removal of shoring system.

3.3.3 Comply with all safety requirements of The Occupational Health and Safety Act and Ontario Building Code.

3.4 Placement - General

3.4.1 Retain Professional Engineer responsible for design and supervision of construction of temporary/permanent retaining structures to verify that Work is carried out in conformance with the design. Retained engineer to provide written acceptance of “As Constructed” shoring before excavation is occupied.

3.4.2 Do not place any part of shoring and bracing systems until permission by the Engineer has been given to proceed.

3.4.3 Have shoring systems installed by personnel with demonstrated competence and experience in this type of work.

3.4.4 Provide and set all excavation, shoring and bracing necessary to prevent cave-in of banks and excavations.

3.4.5 Install shoring so that there is no loose material or voids between shoring and sound undisturbed soil.

3.4.6 Set all shoring to a true vertical and to dimensions and elevations indicated on shop drawings.

3.4.7 Do not encase any part of temporary structure in the structural concrete of the permanent structure without written permission from the Engineer.

3.4.8 If bracing members, such as walers, etc., are to be removed during construction, timing and procedure for removal shall not induce stresses in permanent structures. Submit removals plan to Engineer for review.

3.5 Soldier Piles and Lagging

3.5.1 Install soldier piles to dimensions and elevations indicated on shop drawings. If soldier piles are installed in predrilled holes, fill void around piles with a lean concrete mix before commencing excavation.

3.5.2 Install walers and/or ringwalers, struts and bracing for soldier piles as excavation proceeds and follow behind as closely as possible with lagging installation. Install lagging to bottom of excavation at the end of each day's work.

3.5.3 Wedge lagging tightly against firm soil at all points. Prevent migration of soil particles through joints in lagging.

3.5.4 If soil has been loosened, remove it and fill void with drypack concrete rammed tightly between the lagging and firm soil.

3.5.5 Fill all voids between lagging and firm soil with drypack rammed tightly in place. Do not leave any voids ungrouted at the end of the workday.

3.5.6 If bracing members, such as walers, etc., are to be removed during construction, timing and procedure for removal shall not induce stresses in permanent structures or bracing members in excess of those allowed by applicable codes.

3.6 Liner Plates

3.6.1 Excavate to depth of one (1) ring and place liner plates, set first ring true to circle and vertical position.

3.6.2 Excavate for next ring and place liner plates. Do not excavate further ahead of liner in place than the width of one ring.

3.6.3 Grout voids between liner plates and ground, by means of a grout pump. Frequency of grouting to suit conditions but not less frequent than after every second ring has been placed. Do not leave any ring ungrouted overnight.

3.6.4 Do not leave the sides of the excavation exposed below the liner plates at the end of the day's work.

3.6.5 Provide reinforcing at openings as required by the design.

3.7 Steel Sheet Piling

3.7.1 Provide temporary guide frames and bracing to hold sheet piles in proper alignment during setting and driving. Install piling to dimensions and elevations indicated on shop drawings.

3.7.2 Install walers and bracings so not to interfere with reinforcing bars or other parts of permanent structures.

3.7.3 Splices in walers shall develop full strength of member in bending, shear and axial compression.

3.7.4 If bracing members, such as walers, etc., are to be removed during construction, timing and procedure for removal shall not induce stresses in permanent structures, nor in steel sheet piling or bracing members in excess of those allowed by applicable codes.

3.7.5 Leave sheeting in place unless otherwise specified.

3.8 Secant Pile Walls

3.8.1 Excavation and construction methods shall result in minimum disturbance of surrounding material. The Contractor shall be required to drill through any boulders and rock encountered in the excavation boring.

3.8.2 The sides of all borehole shall be kept intact and no loose material shall be permit-ted to fall into the bottom of the boreholes. The Contractor's boring equipment shall be able to sink a steel casing to support the sides of all boring.

3.8.3 The Contractor shall be responsible for the program and sequence of construction which is dependent on the rate of gain of strength of primary piles affects the time within which secondary piles can be formed. The concrete mix may include addi-tives to control the rate of gain of strength, particularly the primary piles. Where the Contractor considers that alternative proposals for the concrete mix are re-quired then evidence of trial mixes should be provided.

3.8.4 Concrete to be placed under high groundwater table shall be using a tremie meth-od of concreting in accordance with CSA A23.1/A23.2.

3.8.5 The caissons shall be socketed with a minimum of 1000mm below the sound bedrock elevation.

3.9 Closed Sheeting for Trenches

3.9.1 Provide and install braced closed sheeting where required for trench construction.

3.9.2 Sheeting system shall be adequate for all loading and pressures and for surcharge effects due to construction equipment and materials in accordance with the provision of The Occupational Health and Safety Act, and The Ontario Building Code.

3.9.3 Where sheeting is to be left in place, the top shall be cut off 1.2 m below grade or as directed.

3.10 Monitoring Deflection of existing infrastructure

3.11 Monitor deflection of shoring systems that retain materials providing support for adjacent foundations at higher levels at least daily. Verify that measured deflections are within design tolerances.

3.12 Monitor elevations at each corner and center of existing structure daily. Report to the Engineer immediately if specified settlement limits are exceeded.

3.13 Monitor and control vibration. Provide continuous monitoring of all structures within the influence zone.

3.14 Submit written records of settlement, deflection, and vibration results to the Engineer weekly.

3.15 Shoring Removals

3.15.1 When footings, walls, slabs and other foundations are in place and backfilling near completion to existing grade, cut down and remove the tops of piles, lagging, or sheet pile to a minimum of 1200 mm below finished grade.

3.16 Notification

3.16.1 Give the Engineer advance notice of shop fabrication, field installation and other phases of the work so as to afford the Engineer reasonable opportunity to inspect the work for compliance with contract requirements. Failure to meet this requirement may be a cause for the Engineer to classify the work as defective.

3.17 Defective Materials and Work

3.17.1 Where factual evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Engineer may have tests, inspections or surveys performed, analytical calculations of structural strength made, and the like, in order to help determine whether the work must be replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the Engineer's opinion, the work may be acceptable.

3.17.2 All testing shall be conducted in accordance with the requirements of the Ontario Building Code and in accordance with the standards given by the Engineer.

3.17.3 Materials or work which fail to meet specified requirements may be rejected by the Engineer whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work incorporating defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Engineer, at no expense to the Owner.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This specification covers the requirements for dewatering procedures to stabilize the ground and keep excavations free of water during any subsurface construction.

1.2 Related Sections

1.2.1 DIVISION 1 – GENERAL REQUIREMENTS

1.2.2 Section 02137 – Bracing and Shoring

1.2.3 Section 02315 – Excavating, Trenching and Backfilling

1.3 References

1.3.1 This specification refers to the following standards, specifications, or publications:

.1 O.Reg. 63/16 – Registrations under Part II.2 of the Environmental Protection Act – Water Taking

.2 OPSS.MUNI 517 – Construction Specification for Dewatering of Pipeline, Utility, and Associated Structure Excavation

.3 OPSS.MUNI 518 – Control of Water from Dewatering Operations

.4 OPSS.MUNI 805 – Temporary Erosion and Sediment Control Measures

.5 A Geotechnical Investigation Report is provided as part of the Bid Documents. Refer to Section 01000 – General Requirements.

1.4 Definitions

1.4.1 Qualified Person - a practicing member of the Association of Professional Geoscientists of Ontario, or a Professional Engineer licensed in the Province of Ontario who meets the requirements set out in paragraph 2 of subsection 3 (3) of the Professional Geoscientists Act, 2000.

1.5 Permits

1.5.1 Where Water Taking for the purpose of Construction Site Dewatering is expected to be less than 50,000 L/day, no permitting is required.

1.5.2 Where Water Taking for the purposes of Construction Site Dewatering is expected to exceed 50,000 L/day, but will be less than 400,000 L/day, the Contractor shall register the activity under the EASR.

1.5.3 Where Water Taking for the purposes of Construction Site Dewatering is expected to exceed 400,000 L/day, the Contractor shall comply with the Terms and Conditions of the PTTW.

1.6 Design and Performance

1.6.1 Engage a Qualified Person with demonstrated competence to design, construct, monitor, and maintain the dewatering system.

1.6.2 Engage the services of a specialist dewatering contractor who has minimum five years' experience in construction dewatering and discharging systems for projects of similar size and complexity.

1.6.3 Coordinate design of dewatering systems with shoring and bracing systems to meet performance requirements.

1.6.4 The dewatering system shall be designed to keep excavations free of water and to permit construction activities to proceed on a firm, dry subgrade.

1.6.5 Dewatering system shall be designed to maintain groundwater level at least 1000 mm below underside of foundation or lower as may be required to fulfill the requirements of these specifications.

1.6.6 The Contractor shall provide a suitable meter, approved by the Engineer, to measure and record the flow rate and total daily volume of the dewatering discharge.

1.6.7 The dewatering system shall be designed to prevent base destabilization, heaving and shearing failure of the bottom of excavation by dewatering groundwater.

1.6.8 Prevent damage to or displacement of adjacent structures from effects of groundwater drawdown.

1.6.9 Install observation well points to monitor groundwater table in accordance with the geotechnical investigation report.

1.6.10 Repair or replace any structure or Works damaged due to inadequate dewatering at no additional expense to the Owner.

1.6.11 Unless otherwise authorized in writing by the Engineer, continue dewatering operation until backfill material around and above the structures is complete.

1.6.12 Temporary pumping shall be provided by the Contractor, if the temporary pumping is required to dewater inside existing structures, manholes or pipeline for pipeline extension.

1.7 Submittals

1.7.1 Submit the following information to the Contract Administrator at least four (4) weeks prior to commencing dewatering operations:

.1 Qualifications of the dewatering contractors.

.2 A General Dewatering Plan which details the Water Taking Plan and the Discharge Plan, prepared by a Qualified Person.

.3 The Water Taking Plan shall address the following details:

.1 An identification of the expected area of influence, having regard to the amount of ground water that will be taken and all calculations and assumptions used to identify the expected area of influence
.2 An analysis of the potential impact of the soil settlement that would occur as a result of the proposed water taking, including an assessment of the impact of the soil settlement on the integrity of infrastructure located in the expected area of influence and all calculations used to assess the potential impact.
.3 Identification of measures that should be implemented, if any, and the circumstances in which they should be implemented, to address the potential impact of the soil settlement.
.4 An analysis of the potential impact of the proposed water taking on other water users in the expected area of influence, including calculations determining whether the volume of water to be taken during the proposed water taking would limit the availability of water for other water users in the area.
.5 Identification of measures that should be implemented, if any, and the circumstances in which they should be implemented, to address the potential impact of the proposed water taking on other water users in the expected area of influence,
.6 An analysis to determine whether a water monitoring program would be needed.
.7 If the analysis referred to in paragraph 6 determines that a water monitoring program would be needed, a description of the program and the circumstances in which it would be needed.
.8 A summary of the qualifications and experience of the person who prepared the plan, and the date the plan was prepared.

.4 The Discharge Plan shall address the following details:

.1 The maximum quantity of ground water, storm water or both to be discharged each day
.2 The location of discharge. Where the discharge location is to land, the discharge location shall not be within an area that is part of a wellhead protection area and that is identified as “WHPA-A” in a source protection plan.
.3 An identification of the method of transfer or discharge that is to be employed under normal operation.
.4 If the method of transfer or discharge is discharge to land or a storm sewer, an identification of the control measures required to minimize erosion and sedimentation from occurring as a result of the discharge of the water or storm water taken.
.5 A statement by the person who prepared the plan that the temperature of the ground water or storm water to be discharged was considered in determining the method of transfer or discharge.
.6 A summary of the qualifications and experience of the person who prepared the plan, including the date the plan is prepared.

.5 A copy of the confirmation of registration of water taking for construction dewatering, where Sector Registration is required,

.6 Need and location of stand-by power generators, including automatic transfer switch, and other noise producing equipment and anticipated noise emission levels.

.7 Submittals of daily groundwater static water elevation level records.

.8 Location of groundwater observation wells.

1.8 Measurement and Payment

1.8.1 All costs for dewatering the site, and for control of surface water shall be included in the total Lump Sum Tender Price.

1.8.2 Payment will be made for work completed during the payment period on a percentage basis of the sum entered in the breakdown of the lump sum price for 02140 - Dewatering, as approved by the Contract Administrator.

2 PRODUCTS

2.1 Equipment

2.1.1 Pipes, wells, deep wells, well-points, pumps, electrical generators and other equipment as required to dewater in accordance with the requirements of this section.

2.1.2 Standby pumps and a generator with effective muffling devices to keep noise levels to levels specified.

2.2 Turbidity Curtain Geosynthetics

2.2.1 Turbidity curtain geosynthetics shall have a grab tensile strength of at least 990 N, meeting CAN/CGSB 148.1, No. 7.3 and be one of geotextile or geomembrane.

2.2.2 Geotextile shall be a woven material. The filtration opening size (FOS) shall be no greater than 300 µm, meeting CAN/CGSB 148.1, No. 10.

2.2.3 Geomembrane shall be a low-permeability synthetic material or a geotextile impregnated with elastomeric spray.

2.3 Filter Bags

2.3.1 Geotextile for filter bags shall be non-woven, polypropylene, Class I according to Table 1 of OPSS 1860 unless otherwise specified in the Contract Documents.

2.4 Control Measure Support

2.4.1 Control measure support for heavy-duty silt fence barrier shall be a separate product or one bonded to silt fence geotextile and be either plastic snow fence mesh, 0.81 mm diameter galvanized wire mesh or 1.63 mm diameter galvanized steel fence with a 5 cm by 10 cm weave and a 0.91 m height.

2.4.2 When a heavy-duty silt fence barrier is installed using a product manufactured with the control measure support bonded to the geotextile it shall be installed with the geotextile on the upstream side or front of the control measure support.

2.5 Posts

2.5.1 Posts to support heavy duty wire-backed silt fence barriers shall be metal T-posts. Metal ties shall be used to secure the silt fence to the metal T-posts.

2.6 Fibre Rolls

2.6.1 Fibre rolls shall be of a consistent internal thickness with even fibre distribution throughout the roll.

2.6.2 Fibre rolls shall be covered on the outside with an open-weave, biodegradable and photodegradable mesh or netting that securely contains the fibres within the rolls.

2.6.3 Fibre rolls shall be filled with 100% organic, biodegradable material such as shredded straw, wood fibres or compost and may contain seed.

3 EXECUTION

3.1 General

3.1.1 When provided by the Owner, the Contractor shall comply with the Terms and Conditions of the Permit to Take Water, including all monitoring requirements, and completion of all supplemental assessments required by the Permit.

3.1.2 A continuous dewatering operation shall be provided to keep the excavations stable and free of water. The excavations shall be monitored to ensure they remain stable and free of water.

3.1.3 The dewatering system shall be maintained and the surrounding area monitored for impacts to items such as, but not limited to, settlement and ground water usage. Any impacts shall be immediately reported to the Contract Administrator.

3.1.4 Discharge of drainage water from construction site, including installation and maintenance of discharge pipe and siltation ponds.

3.1.5 Coordinate dewatering work with requirements of other trades and units of work affected by dewatering operations.

3.1.6 Implement a temporary pumping system or temporary diversion swale(s) for the purpose of diverting existing flows or potential surface runoff around the work area, when and as required.

3.2 Installation

3.2.1 Dewatering

.1 Install dewatering equipment and dewater to required level before proceeding to excavate when excavation will be made into sands, silts, and gravel layers.

.2 Take corrective measures as necessary to maintain groundwater level at a level necessary to meet performance requirements.

3.2.2 Groundwater Observation Wells.

.1 The Contractor shall conduct a groundwater quality assessment prior to commencing the dewatering activities in order to confirm the water quality parameters and provide a copy of the certified laboratory results to the Engineer.

.2 The Contractor to install and maintain observation wells within the excavation to monitor effectiveness of dewatering. Observation wells to be suitable for monitoring groundwater 3000 mm below the foundation.

3.2.3 Movement Monitoring Markers.

.1 Where indicated on the drawings, install and maintain markers to monitor horizontal and vertical movements of existing structures. Take measures to prevent damage to existing structures. Repair damage to structures due to dewatering at no cost to the Owner. Submit copies of the record to the Contract Administrator weekly. Establish two (2) independent deep seated benchmarks within reasonable sighting distance of each structure to be monitored. Protect benchmarks during course of construction.

3.3 Dewatering Discharge Requirements

3.3.1 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas as required.

3.3.2 Water from dewatering operations shall be directed to a sediment control measure and/or a vegetated discharge area according to OPSS 805 prior to discharge to the environment.

3.3.3 Discharge water through siltation ponds which will provide sufficient detention time so that discharged water will meet the requirements of Provincial regulation, local by-laws and these specifications. Contractor is responsible for monitoring the water quality.

3.3.4 When water is discharged from a sediment control measure or a vegetated discharge area to the environment, it shall be done in a manner that does not cause erosion or other damage to adjacent lands.

3.3.5 Obtain approval from the Owner prior to discharge of water to a sewer system or treatment facility.

3.3.6 Comply with all other required approvals for dewatering operations prior to and during discharge of water.

3.4 Flotation of Structures

3.4.1 Maintain groundwater at a sufficiently low level to prevent damage or displacement of structures by groundwater pressures.

3.4.2 Protect completed structures or part of completed structures which would suffer displacement of other damage as a result of dewatering equipment failure by providing:

.1 Standby dewatering equipment connected directly to electrical generators which will engage automatically in case of power failure.

.2 A positive means by which the structures may be flooded with water to neutralize exterior hydraulic pressures.

.3 A combination of the two (2) alternatives above.

3.4.3 Coordinate and obtain all required power supply including transformers suitably sized service entrance and automatic operation in the event of power failure.

3.5 Monitoring Groundwater Level

3.5.1 Take readings or groundwater level two (2) times a day for the duration of the dewatering period. Keep a written record of groundwater levels. Submit one copy of the records to the Engineer at the end of each week of operations.

3.5.2 Maintain a log of the water takings. This record shall include the dates and times of water takings and the total measured amounts of water pumped per day that water is taken. All water taking records shall be kept onsite at all times and shall be available for inspection by the Owner or by a Provincial Offices immediately upon request.

3.6 Monitoring Movements of Existing Structures

3.6.1 Take readings prior to, during, and after dewatering operations (twice weekly) to record horizontal and vertical movements with respect to an established reference point for the duration of the dewatering period.

3.6.2 The Contractor shall submit the readings to the Engineer weekly.

3.6.3 Baseline (three repeatable readings) prior to excavation or shoring work shall be recorded.

3.7 Inspection of Dewatering Activities

3.7.1 The Contractor shall inspect the dewatering activity at a minimum of twice daily at each discharge point to access the scouring, aeration and turbidity levels.

END OF SECTION

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the supply, placement, maintenance, and removal of the turbidity curtain.

1.2 REFERENCES

1.2.1 The requirements outlined in OPSS.MUNI 805 and OPSD 219.260 shall apply to the supply, placement, maintenance, and removal of the turbidity curtain.

2 EXECUTION

2.1 CONSTRUCTION

2.1.1 The turbidity curtain is to be installed in accordance with OPSD 219.260, in a manner to promote fish dispersion away from the work area for the installation of the new 400mmØ raw water intake pipe, both at the shoreline and around the intake structure. The turbidity curtain shall be removed upon completion of the installation and site restoration, with authorization of the Contract Administrator

2.2 MEASUREMENT FOR PAYMENT

2.2.1 There will be no measurement for payment. Payment will be by lump sum for the supply, placement, maintenance, and removal of the turbidity curtain.

2.3 BASIS OF PAYMENT

2.3.1 Payment at the contract price will be 60% for initial installation and 40% at project completion.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the supply, placement, maintenance, and removal of light duty silt fence barrier.

1.2 REFERENCES

1.2.1 The requirements outlined in OPSS.MUNI 805 and OPSD 219.110 shall apply to the supply, placement, maintenance, and removal of light duty silt fence barrier.

2 EXECUTION

2.1 CONSTRUCTION

2.1.1 Light duty silt fence barriers shall be installed in accordance with OPSD 219.110 and shall be removed by the Contractor after a period of six months from project completion, unless directed by the Engineer to do so at an earlier date.

2.2 MEASUREMENT FOR PAYMENT

2.2.1 There will be no measurement for payment. Payment will be by lump sum for the supply, placement, maintenance, and removal of light duty silt fence barrier.

2.3 BASIS OF PAYMENT

2.3.1 Payment at the contract price will be 60% for initial installation and 40% at project completion.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers to the supply, placement, maintenance, and removal of straw bale flow check dams

1.2 REFERENCES

1.2.1 The requirements outlined in OPSS.MUNI 805 and OPSD 219.180 shall apply to the supply, placement, maintenance, and removal of straw bale flow check dams

2 EXECUTION

2.1 CONSTRUCTION

2.1.1 Straw bale flow check dams shall be installed in accordance with OPSD 219.180 and shall be removed by the Contractor after a period of six months from project completion, unless directed by the Engineer to do so at an earlier date.

2.2 MEASUREMENT FOR PAYMENT

2.2.1 There will be no measurement for payment. Payment will be by lump sum for the supply, placement, maintenance, and removal of straw bale flow check dams

2.3 BASIS OF PAYMENT

2.3.1 Payment at the contract price will be 60% for initial installation and 40% at project completion.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers close-cut clearing and grubbing of trees and brush to facilitate construction operations.

1.2 REFERENCES

1.2.1 Close-Cut Clearing & Grubbing shall be completed in accordance with OPSS.MUNI 201 and the Contract Drawings.

2 EXECUTION

2.1 CONSTRUCTION

2.1.1 The Contractor shall perform close cut clearing and grubbing within the clearing limits. All clearing materials shall become the property of the contractor for disposal. All grubbing material shall be delivered the Town Landfill and stockpiled where indicated by the Town's Foreman

2.2 MEASUREMENT FOR PAYMENT

2.2.1 There will be no measurement for payment. Payment will be by lump sum for the Close Cut Clearing & Grubbing in the areas required to complete the work as indicated on the Contract Drawings.

2.3 BASIS OF PAYMENT

2.3.1 Payment at the Contract Price for the above referenced tender item shall be full compensation for all labour, equipment, and material to do the work.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers:

.1 Earth excavation related to site grading & access.

.2 Rock excavation related to site grading & access.

.3 Supply and placement of granulars for site grading and access at locations detailed in the contract drawings and shall be accounted for in the respective tender item.

.4 The supply and placement of Geotextile and Geogrid as shown in the contract drawings.

1.2 REFERENCES

1.2.1 General

.1 Excess material shall be managed in accordance with OPSS.MUNI 180 and the associated Special Provision

1.2.2 Earth Excavation

.1 OPSS.MUNI 206

1.2.3 Rock Excavation

.1 OPSS.MUNI 120

.2 OPSS.MUNI 206

.3 OPSD 205.020

.4 OPSD 205.030

.5 OPSD 205.040

.6 OPSD 205.050

1.2.4 Supply and Placement of Granulars

.1 OPSS.MUNI 314

.2 OPSS.MUNI 501

.3 OPSS.MUNI 1010

1.2.5 Supply and placement of Geotextile and Geogrid

.1 OPSS.MUNI 206

.2 OPSS.MUNI 1860

2 PRODUCTS

2.1 GRANULARS

2.1.1 Granular “A” shall be according to OPSS.MUNI 1010

2.1.2 Granular “B” shall be Type I according to OPSS.MUNI 1010.

2.2 GEOTEXTILE AND GEOGRID

2.2.1 Geotextile shall be Layfield non-woven LP8 or equivalent, with grab tensile strength not less than 911N and AOS no larger than 0.3mm.

2.2.2 Geogrid shall be Terrafix TBX2500, or equivalent.

3 EXECUTION

3.1 CONSTRUCTION

3.1.1 Earth Excavation

.1 Earth Excavation shall be completed in accordance with OPSS.MUNI 206.

.2 The Contractor shall be responsible for the management and disposal of all excess excavated materials from grading works. Granular materials shall be delivered to the Town’s Boom Camp Road Pit and left in a neat and uniform manner. Native materials shall be delivered to the Town of Blind River Municipal Landfill located at 1182 Highway 17. The Contractor must discuss with the Town Foreman in advance to identify the locations for disposal, and materials shall be leveled and left in a neat and uniform manner acceptable to the Town Foreman.

3.1.2 Rock Excavation

.1 Rock Excavation shall be completed in accordance with OPSS.MUNI 206. The excavation of rock will be completed by hoe ram or by blasting. Rock blasting shall be conducted in accordance with OPSS.MUNI 120.

.2 If blasting is selected as the rock removal method, a pre-blast survey shall be conducted in accordance with OPSS 120.07.03. Monitoring shall be conducted in accordance with OPSS 120.07.05 only when blasting is completed within 250m of a residence. In accordance with OPSS 120.07.06 blasting mats shall be used to limit all potential fly rock.

.3 The Contractor shall be responsible for the management and disposal of all excess excavated materials. Excess material shall be managed in accordance with OPSS.MUNI 180 and section TI.58 of the Tendering Information.

.4 The Contractor shall notify the Contract Administrator sufficiently in advance of any rock excavation, such that the Contractor Administrator can arrange for a topographic survey, at the Owner’s expense, of the stripped rock prior to blasting.

3.1.3 Supply and Placement of Granulars

.1 Supply and placement of Granular “A” and Granular “B” shall be completed in accordance with OPSS.MUNI 314 and OPSS.MUNI 501 at the grade and locations specified in the contract drawings.

.2 Subbase and base materials shall be compacted in accordance with OPSS.MUNI 501.

3.1.4 Supply and placement of Geotextile and Geogrid

.1 Geogrid and geotextile shall be placed in areas as specified on the Contract Drawings. The Terrafix TBX2500 geogrid shall be placed directly on top of the Geotextile, spanning the subdrain trenches. Adjacent sections of geogrid and geotextile shall be overlapped a minimum of 1.0 metre.

.2 Should the geogrid or geotextile become damaged it shall be repaired by placing a piece of geogrid large enough to cover the damaged section with a minimum 1.0 metre overlap.

3.2 MEASUREMENT FOR PAYMENT

3.2.1 There will be no measurement for payment. Payment shall be by lump sum for site grading & access.

3.3 BASIS OF PAYMENT

3.3.1 Payment at the Contract Price shall be full compensation for all labour, equipment, and material to do the work.

1 GENERAL

1.1 Scope

1.1.1 This Section covers the requirements for excavating, backfilling, and compacting trenches for the installation of subdrains, sanitary service; pipe culverts, and infrastructure as specified.

1.2 Related Sections

1.2.1 DIVISION 1 – GENERAL REQUIREMENTS

1.2.2 Section 02137 – Bracing and Shoring

1.2.3 Section 02140 – Dewatering

1.2.4 Section 02362 – Dust Control

1.2.5 Section 02530 – Sanitary Service

1.2.6 Section 02532 – Subdrains

1.2.7 Section 02641 – Pipe Culverts

1.3 References

1.3.1 OPSS.MUNI 180 – Management of Excess Material

1.3.2 OPSS.MUNI 1205 – Clay seal.

1.3.3 OPSS.MUNI 1303 – Admixtures for Concrete

1.3.4 OPSS.MUNI 1359 – Unshrinkable Backfill

1.3.5 OPSS.MUNI 1860 – Geotextiles

1.3.6 O. Reg. 406/19: On-Site and Excess Soil Management

1.3.7 Rules for Soil Management and Excess Soil Quality Standards

1.3.8 O. Reg. 153/04: Records of Site Condition

1.3.9 O. Reg. 347: General – Waste Management

1.3.10 Geotechnical Investigation Report provided as part of the Bid Documents. Refer to Section 01000 – General Requirements.

1.3.11 Local Municipal Standards

1.4 Definitions

1.4.1 Common Excavation

.1 Common excavation is defined as material, of whatsoever nature, excavated to complete works as specified and indicated and includes but not necessarily limited to: earth, trees, tree stumps, deadheads, pipes, tanks, masonry, asphalt pavement, concrete sidewalks, concrete pavements, concrete curbs and gutters, timber, hard pan, shale fractured shale, logs, quicksand, fill, cinders, snow, ice, frost, any combination of these with normal or abnormal earth conditions, or any other obstacles encountered in the excavation, all of which must be removed.

1.4.2 Select Excavated Material

.1 Selected excavated material is defined as excavated material that is free from cinders, ashes, refuse, vegetable or organic matter, boulders, rocks, or stones with nominal dimensions greater than 100 mm, paving material, timbers, unbroken or frozen masses of earth, and other material which in the opinion of the Engineer is unsuitable. Selected excavated material to have properties to meet specified compaction requirements.

1.4.3 Borrow Material:

.1 Material, imported from other sites, to be in accordance with Part 2 of this section.

1.4.4 Soil

.1 means unconsolidated naturally occurring mineral particles and other naturally occurring materials resulting from the natural breakdown of rock or organic matter by physical, chemical or biological processes that are smaller than 2 millimeters in size or that pass the US #10 sieve.

1.4.5 Rock

.1 means natural beds or massive fragments of the hard, stable, cemented part of the earth's crust, either igneous, metamorphic, or sedimentary in origin that may or may not be weathered, and includes boulders having a volume of 1 m^3 or greater.

1.4.6 Topsoil

.1 material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.4.7 Waste

.1 excavated material unsuitable for use in work or surplus to requirements.

1.4.8 Excess Soil

.1 means soil, or soil mixed with rock, that has been excavated as part of a project and removed from the project area for the project.

1.4.9 Abbreviations

.1 SPMDD for Standard Proctor Maximum Dry Density.

.2 OHSA for Occupational Health and Safety Act.

.3 OPSS for Ontario Provincial Standard Specification.

1.5 Site Conditions

1.5.1 Subgrade Conditions

.1 Refer to geotechnical investigation, soil sample chemical analysis and hydrogeological study reports.

1.5.2 Existing Grades

.1 Contours and spot elevations indicated on the Drawings give approximate site grades at time of tendering.

.2 Actual grades may vary slightly.

.3 Notify the Engineer of any significant discrepancy in the existing grades before disturbing the site conditions.

1.5.3 Existing Utilities and Services

.1 Known underground services and surface utility lines are indicated on Drawings. No guarantee is given of completeness or accuracy.

.2 Maintain existing utilities which must remain in service in or adjacent to the excavation.

.3 Record locations of underground utility lines.

.4 Repair damage to existing utility lines and services resulting from work under this Section at no cost to the Owner.

.5 Notify utilities prior to excavating.

1.5.4 Any soils encountered that are suspected to be impacted or hazardous will be tested by the Engineer. Any soils found to exceed the criteria under the “Soil, Groundwater and Sediment Standards for the use under Part XV.1 of the Environmental Protection Act” dated July 1, 2011, but determined to be non-hazardous based on the leachate quality criteria under Schedule 4 on O.Reg 347 as performed by the Engineer, will be considered impacted. Payment will be through Contract Contingency. Any further necessary determination of hazardous waste classification will be carried out by the Engineer using the Leachate Quality Criteria as per “Landfill Disposal Option” under O.Reg. 558/00. Payment for removal, transportation and disposal of hazardous soil/materials will be extra to the Contract.

1.5.5 Excess soils generated should be characterized and handled in accordance with the Excess Soil Management O.Reg 406/19 and other related regulatory amendments related to the management, reuse and off-site disposal of excess soil.

1.6 Submittals

.1 Shop drawings.

.1 Submit, for record purposes, shop drawings detailing side slopes for excavations in open cut. Specifically show details of transitions between open cut and excavation shoring systems.

.2 Provide shop drawing showing temporary shoring system (if applicable)

.3 Shop drawings to bear seal and signature of a professional engineer licensed to practice in Ontario.

.2 Submit as Constructed Drawings

.1 Provide copies of all Utility locate forms provided by the Owners of the various buried utility plant.

.2 Record locations and elevations of all new utilities installed, and existing utilities encountered.

.3 Record contours of the final grade.

.3 Samples

.1 Submit three (3) samples of:

.1 Non-woven geotextile.

.2 Woven geotextile.

1.7 Measurement and Payment

1.7.1 All costs for excavating, trenching, and backfilling, except for excavating in rock and rock removal, shall be included in the total Lump Sum Tender Price.

1.7.2 Payment will be made for work completed during the payment period on a percentage basis of the sum entered in the breakdown of the lump sum price for 02135 – Excavating, Trenching and Backfilling, as approved by the Contract Administrator.

1.7.3 Payment for Rock Removal shall be made from the Contingency Allowance, or from the Provisional Items where Bid items are identified in the Form of Tender.

.1 Volume of rock excavated for trenches is to be determined by the product of the following dimensions measured in place:

.1 Height: vertical distance from rock surface to bottom of designed trench.

.2 Width: actual width of trench measured horizontally limited to pipe O.D. plus 600 mm or the maximum trench width specified on the Contract Drawings.

.3 Length: measured horizontally along the centerline of the trench.

.2 The volume of rock excavation for structures is to be determined by product of following dimensions:

.1 Height: vertical distance from rock surface to bottom of working slab.

.2 Horizontal: dimension of external surface of structure plus 300 mm clearance all around structure.

.3 Volume of rock excavation for boulders and rock fragments to be determined by product of three maximum rectilinear dimensions.

.3 Volume of rock excavation for boulders and rock fragments to be determined by the product of three maximum rectilinear dimensions.

1.7.4 All other unauthorized excavation made to elevation below the founding level to be remedied at Contractor's expense.

2 PRODUCTS

2.1 Materials

2.1.1 Granular `A': OPSS 1010.

2.1.2 Granular `B', (Type I): OPSS 1010.

2.1.3 Clay Seal: OPSS 1205.

2.1.4 19 mm Clear Crushed Stone: OPS 1004 – Crushed Rock composed of hard, uncoated angular fragments produced from rock formations or boulders of uniform quality.

2.1.5 Imported Fill Material: Non-organic clean fill compactable to specified density and free from frozen lumps, rubble, debris and rocks or boulders with nominal size larger than 100 mm. Material subject to acceptance by Geotechnical Consultant. Fill material to be analyzed and classified in accordance with MECP Decommissioning Guidelines.

2.1.6 Select native site material:

.1 Excavated material approved by the Engineer.

.2 Material free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks and boulders over 150 mm in any dimensions, or other deleterious materials.

2.1.7 Unshrinkable Backfill:

.1 Unshrinkable backfill to OPSS 1359

.2 Admixtures shall conform to OPSS 1303 and the latest MTO designated sources list. Calcium chloride or pozzolanic mineral admixtures shall not be used. Air entraining admixtures may be added if desired by the Contractor.

2.1.8 Pea Gravel: Roughly spheroidal in shape, nominal diameter size 5 mm to 10 mm.

2.1.9 Natural Sand: CAN/CSA-A23.1.

2.1.10 Non-Woven Geotextile

.1 Non-woven needle punched staple fibre polymer geotextile: OPSS 1860.

.1 Equivalent opening size of 140 microns.
.2 Acceptable products include:
.1 270R by Terrafix Geosynthetics Inc.
.2 Mirafi P-150 by Dominion Textile Inc.

.2 Non-woven needle punch polypropylene geotextile: OPSS 1860.

.1 Equivalent opening size of 145 microns.
.2 Acceptable products include:
.1 TS800 by Terrafix Geosynthetics Inc.

2.1.11 Woven Geotextiles

.1 Woven geotextile comprised of two or more sets of filaments interlaced at right angles: OPSS 1860.

.1 Ball burst strength of 200 Newton
.2 Equivalent opening size of 500 microns.
.3 Acceptable products include:
.1 Terratrack 200W by Terrafix Geosynthetics Inc.
.2 Mirafi 600X by Dominion Textile Inc.

2.1.12 Mudmat and Fill Concrete shall have a minimum 28-day compressive strength of 20 MPa. Refer to Section 03300 – Cast-in-Place Concrete.

2.1.13 Water

.1 Potable water from municipal potable water source.

3 EXECUTION

3.1 General

3.1.1 All excavations and trenches shall be kept stable and dry.

3.1.2 Provide Bracing and Shoring according to Section 02137 – Bracing and Shoring, as required.

3.1.3 Dewater excavations in accordance with Section 02140 – Dewatering. Do not excavate below groundwater table until groundwater level is lowered to the satisfaction of the Engineer.

3.1.4 Provide Dust Control in accordance with Section 02362 – Dust Control

3.2 Protection of Existing Features

3.2.1 Existing buried utilities and structures:

.1 Size, depth and location of existing utilities and structures as indicated on the drawings are for guidance only. Completeness and accuracy are not guaranteed.

.2 Prior to commencing any excavation work, notify the Engineer and/or applicable authorities having jurisdiction. Establish the location and state of use of buried utilities and structures on and adjacent to site. The Owner or authorities having jurisdiction are to clearly mark such locations to prevent disturbance during work.

.3 Confirm exact locations and depth of buried utilities by careful test excavations.

.4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered, and provide temporary supports where required.

.5 Where utility lines or structures exist in area of excavation, obtain direction of Engineer before relocating.

.6 Remove obsolete or abandoned buried services within 2 m of foundations: cap cut-offs.

.7 Verify that existing services are not damaged by the construction procedure

.8 Record location of maintained, re-routed and abandoned underground lines.

.9 Protect utilities from frost and freezing.

3.2.2 Existing buildings and surface features:

.1 Adequately protect benchmarks, layout markers, survey markers and geodetic monuments.

.2 Conduct, with Engineer condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by work.

.3 Protect existing buildings and surface features which may be affected by work from damage while work is in progress. In event of damage, immediately make repair to approval of Engineer.

3.2.3 Excavations

.1 Protect bottoms of excavations from freezing, both during and after construction. Do not disturb or weaken subgrade in any way.

.2 Direct surface water runoff away from all open excavations. Provide and maintain temporary drainage ditches/swales and other diversions outside of excavation limits.

3.3 Site Preparation

3.3.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

3.3.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.4 Stockpiling

3.4.1 Stockpile fill materials in areas designated. Stockpile granular materials in manner to prevent segregation.

3.4.2 Protect fill materials from contamination.

3.4.3 Do not stockpile material in a manner or location that will interfere with site operation or drainage.

3.4.4 Apply water, sodding or other means as required to provide continuous control of dust from drifting or blowing.

3.4.5 Crown, shape and tarp stockpiles as required to promote runoff and minimize increase in moisture content.

3.4.6 When insufficient space is available to allow placing of excavated material on the right-of-way, the Contractor shall load, haul and stockpile such excavated material at an offsite location arranged for by and at the sole expense of the Contractor. When the underground work has been installed, the Contractor shall, at the Contractor's own expense, bring back as much acceptable material.

3.4.7 All surplus materials shall be disposed in accordance with the contract requirements for impacted materials and current regulations.

3.4.8 The Contractor shall provide a letter from the temporary offsite disposal site property owner accepting the material, placement, grading and restoration and releasing the Municipality of any responsibility to the satisfaction of the Municipality.

3.5 Cold Weather Requirement

3.5.1 Obtain written permission from the Engineer before starting excavation in frozen ground.

3.5.2 Do not let subgrade at final foundation excavation level to freeze. Provide insulated blankets, heated enclosures or similar means to suit conditions encountered.

3.6 Construction Procedure

3.6.1 Employ construction procedures to suit conditions encountered and prevent undermining existing or installed foundations and weakening of material which supports foundations already in place.

3.6.2 Undertake work in a safe manner. Take full responsibility for site safety. Comply with safety requirements of the Occupational Health and Safety Act (OHSA).

3.6.3 Employ construction procedures so that foundation at adjacent higher levels are not disturbed or weakened.

3.7 Excavating and Backfilling for Trenches

3.7.1 Excavating

.1 Excavate trenches to lines, widths and grades as specified in the Contract Documents. Maintain bedding thickness under utilities or duct banks.

.2 Excavate trenches a minimum of 300 mm wider on each side than the outside pipe diameter. Excavate trenches to lines, grades, elevations and dimensions as indicated on the Contract Drawings.

.3 Unless otherwise authorized by the Engineer in writing, do not excavate more than 15 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.4 Excavate within trench shoring system in accordance with OHSA. Coordinate the work under this Section with Section 02137 - Bracing and Shoring and Section 02140 – Dewatering. Verify that trench is dewatered to ensure that groundwater is lowered and maintained at least 1000 mm below the base of the trench until backfilling is complete.

.5 Provide side slopes of excavations in open cuts suitable to the conditions encountered and in accordance with requirements of OHSA. Stability of side slopes is time dependent. Slopes generally become increasingly unstable with time. Remove all slides and cave-ins, without extra compensation, at whatever time and circumstances they may occur. Where side slopes interfere with the stability of existing structures or utilities, provide temporary shoring to prevent damage.

.6 Where rock is encountered, use conventional excavation methods to remove rock. Do not use explosives.

.7 Do not disturb soil within branch spread of trees or shrubs that are to remain. Where excavation is required to be completed through root zones, excavate by hand or by hydro-vac. Cut exposed roots with sharp axe or saw in accordance with approved arboricultural methods.

.8 Dispose of surplus and unsuitable excavated off site.

.9 Notify the Engineer if bottom of excavation appears to be unsuitable for foundation. Do not excavate below the specified level or place concrete or other materials on subgrade until the inspection has been undertaken and permission to proceed has been granted, in writing, by the Engineer.

.10 Sub-excavate unsuitable material and backfill as directed, in writing, by the Engineer.

.11 Excavate with care adjacent to existing structures around existing utilities and pipelines. Provide temporary supports as required. Prevent damage.

.12 All unauthorized excavation made to elevation below the founding level to be remedied at Contractor's expense. Correct unauthorized over-excavation as follows:

.1 Fill under bearing surfaces and footings with unshrinkable fill or Granular A per OPSS 1010 compacted to not less than 100% SPMDD.
.2 Fill under other areas with Granular B per OPSS 1010, compacted to not less than 100% of corrected SPMDD.
.3 Hand trim, make firm, and remove loose material and debris from excavations.
.4 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
.5 Clean out rock seams and fill with concrete mortar or grout to approval of the Engineer.
.6 Obtain Engineer's approval of completed excavation.

3.7.2 Backfilling and Compaction

.1 Trenches to be backfilled with select native material compacted to minimum 95 per cent SPMDD at a placement moisture content within 2 per cent of optimum. Lifts of loose height not greater than 300mm at a placement moisture content within 2 per cent of optimum.

.1 Where trenches are located within 2.0m of any roadway, driveway, or parking area, the upper 1.0m of trench backfill shall be compacted to minimum 98% SPMDD.

.2 Where there is a shortfall of suitable native material, Contractor is responsible for importing suitable material at no extra cost to the Owner.

.3 Before proceeding with backfilling, verify that waterproofing for underground structures where indicated, have been completed.

.4 Do not backfill to elevation higher than the finish grades.

.5 Use equipment for backfilling and compaction that would not impose loads greater than those indicated or will damage the surface finishes.

.6 Puddling is not permitted.

.7 Fill in low spots after settlement and re-grade as necessary until settlement ceases.

.8 Remove all debris and surplus materials from site on completion of work.

.9 Place backfill material in uniform layers not exceeding 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer. Remedy trench excavation weakened or destabilized by improper construction procedure or inadequate dewatering at no cost to the Owner.

.10 Place non-woven geotextile against undisturbed ground and wrap around the bedding.

.11 Place and compact bedding material in lifts of 150 mm compacted to 95% SPMDD on geotextile on undisturbed ground.

.12 Lay the pipes and backfill trench to a minimum height of 300 mm above the pipe with Granular `A' in lifts of 150 mm compacted to 98% SPMDD.

.13 Backfill the rest of the trench with selected excavated material in lifts of 150 mm compacted to 95% SPMDD.

.14 Under roadways and paved areas backfill trenches with Granular `B' in lifts of 150 mm compacted to 100% SPMDD to underside of road subgrade.

3.8 Haulage

3.8.1 Haul off site and dispose of at an approved site surplus excavated material not required or suitable for backfill.

3.8.2 The Owner has the right of first refusal for excess material that is to be removed.

3.8.3 Haul surplus excavated material from site in tight bodied trucks or other means. Clean truck tires prior to exiting site. Prevent hauled material from spilling on roads. Promptly clean up if such spill occurs and maintain roads free of any tracked soil. Maintain roads free of any tracked soil.

3.9 Disposal Sites

3.9.1 Make arrangements for disposal of excavated material off the site.

3.9.2 Obtain from property owner of disposal site a written agreement setting out terms, conditions, and ultimate responsibility for materials as placed.

3.9.3 On completion of the Works, provide the Owner with a release from the owner of disposal site.

3.10 Dust Control

3.10.1 Throughout construction period, provide adequate dust control on the site by watering or use of other accepted dust control materials.

3.10.2 Apply water or other material as often as necessary to provide continuous control of dust from drifting or blowing.

3.10.3 Eliminate dust and dirt in areas where electrical equipment, metering instruments and similar equipment requiring interior cleanliness are being installed or assembled by providing temporary enclosures, covers for openings, or other means of protection.

3.11 Impacted Soils

3.11.1 If impacted soils are encountered during excavation, the site and stockpiled soils will be characterized by the Engineer in accordance with O.Reg 153/04.

3.11.2 Refer to soils reports for characteristics of “Impacted Soils.”

3.11.3 Impacted soil that is determined to be excess soils and require off-site disposal need to characterized and handled in accordance with the Excess Soil Management Regulation 406/19 and other related regulatory amendments related to the management and reuse of excess soil. Trucks used to dispose of impacted soils shall be covered.

3.11.4 Disposal of soil identified as impacted excess soils will be paid as a provisional item.

3.12 Field Quality Control

3.12.1 Inspection

.1 The Owner will retain an independent Geotechnical Consultant to inspect foundations for its suitability prior to placement of concrete or other materials.

.2 Notify the Owner sufficiently in advance of operations, to provide field inspection.

.3 On reaching specified excavation level, request an inspection of subgrade by the Geotechnical Consultant.

.4 Provide all facilities to enable proper inspection.

.5 Do not excavate below the specified level or place concrete or other materials on subgrade until the inspection has been undertaken and permission granted to proceed in writing by the Engineer.

.6 Co-operate with the Owner's Representative and testing company by scheduling the placing and compacting of fill and backfill so tests can be progressively taken. Provide assistance, as required, to facilitate compaction and material testing.

.7 The cost for the initial material and compaction testing shall be borne by the Owner. If the compacting Work does not meet the specified requirements, the Contractor shall perform further compacting Work until the specified requirements are met and pay the cost of further testing to establish proof of compliance with the specified compaction.

.8 Notify the Engineer if bottom of excavation appears to be unsuitable for foundation. Excavate unsuitable material and backfill as directed by the Engineer.

3.12.2 Soil Compaction Densities

.1 Where specified, compaction densities are percentages of SPMDD in accordance with ASTM D698.

.2 Field tests of soil compaction densities will be carried out in accordance with ASTM D6938.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This specification covers the requirements for dust suppressants and their application.

1.2 Related Sections

1.2.1 DIVISION 1 – GENERAL REQUIREMENTS

1.2.2 Section 02311 – Site Grading and Access

1.2.3 Section 02315 – Excavating, Trenching and Backfilling

1.2.4 Section 02480 – Horizontal Directional Drilling

1.2.5 Section 02481 – Earth and Rock Trenching

1.2.6 Section 02911 – Topsoil and Sod

1.3 References

1.3.1 CGSB 15.1-92 – Standard for Calcium Chloride

1.3.2 OPSS 2503 Magnesium Chloride Solid and Magnesium Chloride Solution

1.4 Measurement and Payment

1.4.1 Work outlined in this section is included in the lump sum tender price.

1.4.2 Payment will be made for work completed during the payment period on a percentage basis of the sum entered in the breakdown of the lump sum price for 02362 – Dust Control, as approved by the Engineer.

1.4.3 No extra compensation will be paid for calcium chloride and water supplied and applied on Saturdays, Sundays or holidays.

1.5 Delivery, Storage and Handling

1.5.1 Supply calcium chloride in quantities and at times as required to mitigate the impacts of dust.

1.5.2 Store bags of calcium chloride in weatherproof enclosures.

2 PRODUCTS

2.1 Materials

2.1.1 Calcium chloride

.1 Calcium chloride solid shall be loose, dry, and according to CAN/CGSB 15.1, Type S, Grade 1.

.2 Calcium Chloride solution shall be according to CAN/CGSB 15.1, Type L, Class 1, shall be homogeneously mixed, and shall contain a minimum 35% by mass of pure calcium chloride, and shall meet the following requirements:

.1 pH: 6 to 9 according to ASTM D 1293.

2.1.2 Magnesium chloride

.1 Magnesium chloride solid shall be in the form of loose, dry flakes or pellets, and shall consist of magnesium dichloride hexahydrate.

.2 Magnesium chloride solution shall contain a minimum of 30% by mass of pure magnesium dichloride hexahydrate.

.3 Magnesium chloride solid shall meet the following requirements:

Material / Property	Solid	Solution
Magnesium Chloride % Minimum	**46.0**	**30.0**
Potassium % maximum	**-**	**0.5**
Sodium % maximum	**-**	**0.7**
Calcium Chloride	**2.0 – 3.0**	**-**
Potassium Chloride	**0.5 – 1.0**	**-**
Sodium Chloride	**0.5 – 1.0**	**-**
pH	**-**	**6 - 9**

2.1.3 Water:

.1 Water shall be free of contaminants that could adversely affect fill material or the environment.

.2 Water shall be free of foreign material that would alter the dust suppressant solution or cause blockage in the spray equipment.

3 EXECUTION

3.1 General

3.1.1 Dust suppressants shall be applied as necessary, to minimize dust nuisance to the surrounding properties.

3.1.2 Water shall be the only dust suppressant applied within two weeks before the placement of any asphaltic concrete materials or the application of surface treatments.

3.1.3 Approved dust suppressants other than water, calcium chloride solid, calcium chloride solution, magnesium chloride solid, magnesium chloride solution, and calcium-magnesium chloride blend shall be applied according to the manufacturer's guidelines and application rates.

3.1.4 Steps shall be taken as necessary to control dust resulting from operations or by public traffic such that it does not:

.1 affect traffic,

.2 enter surface waters, or

.3 escape beyond the property limits to cause a nuisance to residents, businesses, or utilities.

3.1.5 Dust suppressants shall be applied in a manner that avoids ponding, runoff, drifting, and tracking of the material beyond the area of application.

3.1.6 Dust suppressant application shall not proceed during periods of rain when the surface is in a saturated condition or on areas of ponded water.

3.1.7 Dust suppressants other than water shall not be applied when weather forecasts indicate a high probability of rainfall in order to minimize loss of the material from the intended area of application. Areas receiving rainfall within 6 hours after application may require reapplication of the material.

3.1.8 Dust suppressants containing waste material shall not be stored on the Owner's property.

3.2 Application

3.2.1 Apply calcium chloride flake with equipment approved by the Engineer, and when directed by the Engineer.

3.2.2 Dust suppressant solutions shall be applied by a pressure distributor. The application rate shall be determined by the Contractor and shall be subject to the approval of the Contract Administrator.

END OF SECTION

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the requirements for the installation of underground/underwater pipelines using the trenchless technology known as horizontal directional drilling (HDD) for the 400mmØ raw water intake line, as well as the carrier lines conduit as showing in the contract drawings. Additionally, design and construction of the sending/receiving pits is covered by this specification.

1.2 REFERENCES

1.2.1 The requirements outlined in OPSS.MUNI 206, OPSS.MUNI 401, OPSS.MUNI 404, OPSS.MUNI 409, OPSS.MUNI 441, OPSS.MUNI 450, OPSS.MUNI 491, OPSS.MUNI 517, OPSS.MUNI 539 and OPSS.MUNI 1842 shall apply to the installation of underground/underwater pipelines using the trenchless technology known as horizontal directional drilling (HDD) for the 400mmØ raw water intake line, the carrier lines, and the design and construction of the sending/receiving pits.

2 PRODUCT

2.1 MATERIALS

2.1.1 Raw water intake lines shall be DR17 HDPE watermain pipe, butt fused.

2.1.2 Carrier lines conduit shall be DR32.5 HDPE.

2.1.3 Tracer wire shall be Solid Copper 12GA with Blue HMWPE insulating cover designed for direct burial.

3 EXECUTION

3.1 CONSTRUCTION

3.1.1 All submissions required by OPSS.MUNI 450 shall be completed, submitted to the Contract Administrator and conform to the requirements of the specifications prior to commencement of HDD operations. Design and installation of the HDD lines shall be the responsibility of the contractor. The methods shown and transition points identified are approximate and it is the responsibility of the contractor to ensure a suitable approach to installation.

3.1.2 The Contract Administrator shall be notified at least 48 hours in advance of commencement of the drilling operations. Operations shall not begin until proper preparations are made.

3.1.3 Grade and alignment tolerances for Horizontal Directional Drilled pipe are as follows:

.1 Horizontal: 50mm

.2 Vertical: 10mm

3.1.4 A tracer wire shall be supplied and installed with the raw watermain pipe.

3.1.5 The Send/Receive Pit shall be designed by the Contractor and constructed according to the requirements of OPSS.MUNI 206 to the depth and dimensions necessary to allow for the installation of the 400mmØ raw water intake and carrier line conduit per the contract drawings. Excavated materials shall be salvaged for reuse as backfill. Backfilling of the send/receive pits shall be completed as per the requirements of OPSS.MUNI 501 with the materials specified in the Contract Drawings. Isolation and dewatering of the sending/receiving pit or rock trench to HDD transition point shall be the responsibility of the Contractor.

3.1.6 The work shall also include the connection of the 400mmØ raw water intake pipe installed via HDD to the 400mmØ raw water intake pipe installed to the northeast by conventional method in rock trenching. The work shall also include connection of the 400mmØ raw water intake pipe to the offshore intake structure.

3.1.7 The Contractor shall be responsible for the management and disposal of excess excavated materials. Excess material shall be managed in accordance with section TI.58 of the Tendering Information.

3.1.8 Watermain testing and commissioning shall be completed in accordance with OPSS.MUNI 441. The Contractor shall provide the Engineer with a copy of all NSF/ANSI 61, NSF 372 and AWWA certificates and/or reports to prove material compliance with the corresponding watermain regulations.

3.2 MEASUREMENT FOR PAYMENT

3.2.1 There will be no measurement for payment for the HDD or sending/receiving pit items. Payment shall be by lump sum.

3.3 BASIS OF PAYMENT

3.3.1 Payment at the contract price for the above referenced tender items shall be full compensation for all labour, equipment and material to do the work including isolation and dewatering, sending/receiving pit design and construction and HDD installations complete with tracer wire.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the removal of trench rock and the installation of the 400mmØ raw water intake pipe and carrier lines conduit, where bedrock is encountered, from the building detailed in the contract drawings to the connection point of the 400mmØ raw water intake pipe installed by horizontal directional drilling methods.

1.2 REFERENCES

1.2.1 The requirements outlined in OPSS.MUNI 120, OPSS.MUNI 206, OPSS.MUNI 403 and OPSS.MUNI 510 shall apply to the installation of the 400mmØ raw water intake pipe and carrier lines conduit.

2 EXECUTION

2.1 CONSTRUCTION

2.1.1 The excavation of trench rock shall be completed by hoe ram or by blasting. Pre-drilling may be required for hoe ram operations to minimize hammering time. Drilling and blasting will require the use of blasting mats. Rock blasting shall be conducted in accordance with OPSS.MUNI 120. Trench rock shall be minimum 0.30m below bottom of pipe elevation with minimum 0.3m sidewall clearance, and extend to finished grade elevation.

2.1.2 If blasting is selected as the rock removal method a pre-blast survey shall be conducted in accordance with OPSS 120.07.03. Monitoring shall be conducted in accordance with OPSS 120.07.05 only when blasting is completed within 250m of a residence. In accordance with OPSS 120.07.06 blasting mats shall be used to limit all potential fly rock. Blasting shall be completed in accordance with all environmental permits, including limiting the resulting pressure waves to avoid harm to fish and wildlife.

2.1.3 The 400mmØ raw water line shall both be connected to at the building connection point as detailed in the contract drawings at one end, and the other end of the 400mmØ raw water intake pipe shall be connected to the 400mmØ raw water intake pipe installed by horizontal directional drilling methods, including all connection hardware and restraints.

2.1.4 The 400mmØ raw water intake pipe shall be installed with cathodic protection per OPSS 442, where applicable.

2.1.5 A conduit shall be installed with the 400mmØ raw water pipe for carrier lines.

2.1.6 A clay seal trench plug shall be installed at the location identified in the contract drawings as part of this item. The clay seal trench plug shall be installed from the pipe bedding elevation to the historical high-water elevation shown in the contract drawings.

2.1.7 Suitable excavated materials shall be salvaged for reuse as trench backfill and compacted to 95% SPMDD. Excess materials shall be managed in accordance with the associated SP.

2.2 MEASUREMENT FOR PAYMENT

2.2.1 There will be no measurement for payment. Payment will be by lump sum for earth and rock trenching, including pipe, conduit and clay seal installation.

2.3 BASIS OF PAYMENT

2.3.1 Payment at the Contract Price for the above referenced tender item shall be full compensation for all labour, equipment, materials to do the work.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the supply and installation of PVC DR18 watermain pipe for the twin 300mmØ raw water lines and the 50mmØ water service line, as shown in the contract drawings, including all fittings, caps, restraints, tracer wire, connections and dewatering as may be required.

1.2 RELATED SECTIONS

1.2.1 Section 02315 – Excavating, Trenching & Backfilling

1.3 REFERENCES

1.3.1 The requirements of OPSS.MUNI 180, OPSS.MUNI 314, OPSS.MUNI 401, OPSS.MUNI 441, OPSS.MUNI 442, OPSS.MUNI 501, OPSS.MUNI 517, OPSS.MUNI 1842, OPSD 802.010, 802.013, OPSD 1101.020, OPSD 1104.010, OPSD 1104.020, OPSD 1105.010, OPSD 1109.011, OPSD 1109.025 and OPSD 1109.030 shall apply to the supply and installation of watermain pipes, water service lines, and all fittings, caps, restraints, tracer wire, connections and dewatering as may be required.

2 PRODUCT

2.1 MATERIALS

2.1.1 Watermain pipes and service line shall be AWWA C900 PVC DR18 Class 235 and be certified to CSA 137.3, or equivalent. Watermain and service line fittings shall be PVC conforming to AWWA C907. M.J. Ductile Iron Fittings will be accepted as an equivalent.

2.1.2 Tracer wire shall be Solid Copper 12GA with Blue HMWPE insulating cover designed for direct burial.

2.1.3 Joint restraints shall be Uni-Flange Series 1390 or equivalent for PVC and NSF Certified clamps for Cast Iron.

2.1.4 Main stops and curb stops shall be Mueller or Cambridge Brass.

2.1.5 Anodes shall be Z-12-24 for new watermain components, service lines and tracer wires.

2.1.6 The Contractor shall provide the Engineer with a copy of all NSF/ANSI 61, NSF 372 and AWWA certificates and/or reports to prove material compliance with the corresponding regulations.

3 EXECUTION

3.1 CONSTRUCTION

3.1.1 The Contractor shall ensure that *"F-6-1 Procedures to Govern Separation of Sewers and Watermains, Ministry of Environment, Conservation and Parks",* is accommodated during installation of the watermain and service lines.

3.1.2 Excavation, trenching, and backfilling shall be in accordance with Section 02315.

3.1.3 Where required, dewatering of the excavation shall be in accordance with Section 02140.

3.1.4 Watermain shall be laid with a minimum cover depth 2.1m and insulated where a depth of 2.1m is not achieved. The twin 300mmØ raw watermain lines shall be installed within the same trench, as detailed in the contract drawings.

3.1.5 The 300mmØ twin raw water lines shall both be capped and restrained at Martin Street for future connection to the twin raw water lines to be placed by others.

3.1.6 All watermains, appurtenances and tracer wire shall be installed with cathodic protection per OPSS 442. Water services shall be installed with horizontal goosenecks.

3.1.7 Anode spacing for cathodic protection shall be as specified in Tables 4 and 5 of OPSS.MUNI 442.

3.1.8 Excavation for watermain installation including services shall be to the roadway subgrade limits or finished grade beyond the roadway. Suitable native materials shall be salvaged and reused as backfill to subgrade elevation or finished grade beyond roadway, compacted to minimum 98% standard proctor density. Installation shall include all materials required, including but not limited to couplers and elbows as well as associated joint restraints and cathodic protection.

3.1.9 The Contractor shall locate the existing watermain identified for connection and determine the appropriate coupler required to make the connection. The Town's operator (PUC) must be onsite when there is work on a commissioned watermain. All operation of Town valves and curb stops must be carried out by PUC Staff and will require a minimum 48hrs advanced notice to the Town and PUC to do so.

3.1.10 Construction shall proceed in such a manner as to isolate areas of work to minimize the amount of disruption within the project site.

3.1.11 New curb stop shall be installed at the property line, or limits identified.

3.2 MEASUREMENT FOR PAYMENT

3.2.1 There will be no measurement for payment. Payment for the twin watermain and water service items will be by lump sum. There will be no separate measurement for connections, caps, elbows, tracer wire, joint restraints and cathodic protection.

3.3 BASIS OF PAYMENT

3.3.1 Payment at the Contract Price shall be full compensation for all labour, equipment, and material to do the work

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the installation of PVC Sanitary Sewer Pipe, Service Connections, Cleanout and dewatering as may be required.

1.2 RELATED SECTIONS

1.2.1 Section 02315 – Excavating, Trenching & Backfilling

1.3 REFERENCES

1.3.1 The requirements outlined in OPSS.MUNI 180, OPSS.MUNI 401, OPSS.MUNI 409, OPSS.MUNI 410, OPSS.MUNI 501, OPSS.MUNI 510, OPSS.MUNI 805, OPSS.MUNI 1841, OPSD 802.010 and OPSD 1006.010 shall apply to the installation of PVC Sanitary Sewer Pipe, Service Connections, Cleanout and dewatering as may be required.

2 PRODUCT

2.1 MATERIALS

2.1.1 Sanitary sewer and sanitary service pipe and fittings shall be PVC DR35 pipe material in accordance with OPSS.MUNI 1841. Sanitary services shall be 150mmØ to the limits detailed in the Contract Drawings. Joints shall be watertight with appropriate gaskets. The Contractor will be responsible for providing supporting documentation.

2.1.2 The granular material required in OPSS.MUNI 410 for the bedding, embedment, and cover shall be Granular “A” and shall be included in these items.

2.1.3 Connections to existing sanitary sewer lines shall be made with factory approved fittings.

3 EXECUTION

3.1 CONSTRUCTION

3.1.1 Excavation, trenching, and backfilling shall be in accordance with Section 02315.

3.1.2 Where required, dewatering of the excavation shall be in accordance with Section 02140.

3.1.3 The Contractor shall prepare a Sewage Bypass Plan to ensure the mainline sewer is in operation at all times during construction. The Contractor must provide appropriate notice to the Town and the Engineer in advance of any scheduled connections or any potential service disruptions.

3.1.4 Sanitary Service laterals shall be 150mmØ installed per OPSD 1006.010 with factory approved tees, extending from the main sewer to extents detailed in the contract drawings. The Contractor shall connect the new sanitary sewer to the existing building as shown on the contract drawings.

3.1.5 Excavation for pipe installation shall be to the roadway subgrade limits or finished grade. Suitable native materials shall be salvaged and reused as backfill to subgrade o finished grade elevation, compacted to minimum 98% standard proctor density. Sanitary service installation shall include restoration of street to existing elevation. Existing road base granulars shall be salvaged for reuse and compacted to 98% standard proctor density.

3.1.6 The Contractor shall be responsible for the management and disposal of excess excavated materials.

3.1.7 The Contractor shall locate existing sewer pipes. The Contractor shall determine elevations and materials of the existing sewer and connect to the new sewer lines ensuring positive flows. Adjustment of proposed connecting sewer line elevations may be required.

3.2 MEASUREMENT FOR PAYMENT

3.2.1 There will be no measurement for payment. Payment will be by lump sum for the installation of the sanitary sewer service.

3.3 BASIS OF PAYMENT

3.3.1 Payment at the Contract Price for the above referenced tender item shall be full compensation for all labour, equipment, and materials to do the work, including CCTV inspection (post), earth trenching, bedding, embedment, cover and backfill to roadway subgrade elevation or finished grade elevation outside the roadway.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the supply and placement of socked pipe subdrain with associated geotextile and clearstone trench.

1.2 RELATED SECTIONS

1.2.1 Section 02315 – Excavating, Trenching & Backfilling

1.3 REFERENCES

1.3.1 The requirements outlined in OPSS.MUNI 180 and OPSS.MUNI 405, OPSS.MUNI 1004, OPSS.MUNI 1860, and OPSD 216.021 shall apply to the supply and placement of socked pipe subdrain with associated geotextile and clearstone trench.

2 PRODUCT

2.1 MATERIALS

2.1.1 Subdrain pipe shall be 150mm diameter perforated corrugated polyethylene pipe with minimum stiffness of 320kPa and wrapped with knitted polyester sock.

2.1.2 Geotextile shall be Terrafix non-woven 270R or equivalent.

2.1.3 Clearstone shall be 19mmØ according to OPSS.MUNI 1004.

3 EXECUTION

3.1 CONSTRUCTION

3.1.1 The Contractor shall supply and install 150mmØ socked subdrain pipe in accordance with OPSS.MUNI 405 and the Contract Drawings. The subdrain trench shall be excavated and wrapped in geotextile, resting on subgrade covered with clearstone, 150mm thickness on top and sides.

3.1.2 Excavation, trenching, and backfilling shall be in accordance with Section 02315.

3.1.3 Where required, dewatering of the excavation shall be in accordance with Section 02140.

3.1.4 The excavation shall be inspected with grade checks and certified by the Contractor prior to placement of the pipe bedding.

3.2 MEASUREMENT FOR PAYMENT

3.2.1 There will be no measurement for payment for the supply and placement of socked pipe subdrain with associated geotextile and clearstone trench. Payment shall be by lump sum.

3.3 BASIS OF PAYMENT

3.3.1 Payment at the Contract price for the above tender items shall be full compensation for all labour, equipment, and material to do the work.

1 GENERAL

1.1 SCOPE

1.1.1 This specification is applicable to the installation of insulation for watermain and sanitary sewer, in areas with less than 2.1m of cover.

1.2 REFERENCES

1.2.1 The requirements of OPSS.MUNI 316, OPSS.MUNI 1605 and OPSD 1109.030 shall apply to the installation of insulation for watermain and sanitary sewer.

2 EXECUTION

2.1 CONSTRUCTION

2.1.1 Insulation shall be placed horizontally spanning the line being protected, or alternatively in a trench configuration in accordance with OPSD 1109.030. Insulation shall be placed between crossing of sewers and watermain or water services.

2.2 MEASUREMENT FOR PAYMENT

2.2.1 There will be no measurement for payment. Payment will be by lump sum for the supply and installation of insulation.

2.3 BASIS OF PAYMENT

2.3.1 Payment at the Contract Price shall be full compensation for all labour, equipment, and material to do the work

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the supply and installation of 300mmØ HDPE pipe culvert and associated granulars, as well as dewatering as required.

1.2 RELATED SECTIONS

1.2.1 Section 02315 – Excavating, Trenching & Backfilling

1.3 REFERENCES

1.3.1 The requirements outlined in OPSS.MUNI 180, OPSS.MUNI 314, OPSS.MUNI 410, OPSS.MUNI 501, OPSS.MUNI 510, OPSS.MUNI 517, OPSS.MUNI 1840, OPSS.MUNI 1841, OPSD 802.010 and OPSD 802.013 shall apply to the supply and installation of 300mmØ HDPE pipe culvert, and associated granulars and dewatering.

2 PRODUCT

2.1 MATERIALS

2.1.1 High Density Polyethylene Pipe (HDPE) shall be smooth wall interior, corrugated exterior with a minimum stiffness of 320 kPa as per OPSS.MUNI 1840.

2.1.2 The granular material required in OPSS.MUNI 410 for the bedding, embedment, and cover shall be Granular “A” and shall be included in this item.

3 EXECUTION

3.1 CONSTRUCTION

3.1.1 Supply and installation of HDPE pipe culvert shall be completed in accordance with OPSS.MUNI 410, OPSD 802.010 and OPSD 802.013. Backfill material shall extend to the underside of the roadway granulars.

3.1.2 Excavation, trenching, and backfilling shall be in accordance with Section 02315.

3.1.3 Where required, dewatering of the excavation shall be in accordance with Section 02140.

3.1.4 Pipe shall be laid within 10mm ± of the design grade. Excavation for pipe installation shall be to the roadway subgrade limits. Suitable native materials shall be salvaged and reused as backfill to subgrade elevation, compacted to minimum 98% standard proctor density. The Contractor shall be responsible for the management and disposal of excess excavated materials. Excess material shall be managed in accordance with the requirements of the Contract.

3.2 MEASUREMENT FOR PAYMENT

3.2.1 There will be no measurement for payment. Payment will be by lump sum for the culvert installation. There will be no measurement of payment for the granular bedding, embedment, cover and backfill material required for the installation of the storm sewer.

3.3 BASIS OF PAYMENT

3.3.1 Payment at the Contract Price shall be full compensation for all labour, equipment, and materials to do the work, including trenching and supply and placement of granulars for bedding, embedment, cover and placement of suitable native backfill to subgrade elevation.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the supply and placement of HL3 asphalt for surface course pavement as shown in the contract drawings.

1.2 REFERENCES

1.2.1 The requirements outlined in OPSS.MUNI 310, OPSS.MUNI 311, OPSS.MUNI 710, OPSS.MUNI 1103, and OPSS.MUNI 1150 shall apply to the supply and placement of HL3 asphalt for surface course pavement.

2 PRODUCT

2.1 MATERIALS

2.1.1 Asphalt Cement shall be PGAC 58-34.

3 EXECUTION

3.1 SUBMISSION AND DESIGN REQUIREMENTS

3.1.1 The Contractor shall submit a Mix Design as specified in OPSS.MUNI 1150.04.01.02.

3.2 CONSTRUCTION

3.2.1 Supply and placement of HL3 Hot Mix Asphalt shall be completed in accordance with OPSS.MUNI 310 including tack coating of all joints.

3.3 MEASUREMENT FOR PAYMENT

3.3.1 There will be no measurement for payment. Payment shall be by lump sum for the supply and placement of HL3 asphalt for surface course pavement.

3.4 BASIS OF PAYMENT

3.4.1 Payment at the Contract Price for the above tender items shall be full compensation for all labour, equipment, and materials to do the work.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the removal of existing asphalt pavement for roadway and entrances.

1.2 REFERENCES

1.2.1 The requirements outlined in OPSS.MUNI 180 and OPSS.MUNI 510 shall apply to the removal of existing asphalt pavement for roadway and entrances.

2 EXECUTION

2.1 CONSTRUCTION

2.1.1 All removal limits shall be sawcut. Asphalt materials shall be removed separately from the underlying granulars resulting in a clean product. Partial depth removal shall be milled.

2.1.2 Asphalt shall remain the property of the Town and shall be delivered to the Town's Boom Camp Road Pit and stockpiled where indicated by the Town's Foreman.

2.1.3 The Contractor shall be responsible for the management and disposal of excess material in accordance with OPSS.MUNI 180.

2.1.4 No reliance upon the asphalt depths indicated shall be made by the Contractor in determining associated removal volumes for bid preparation. The Contractor shall estimate for themselves prior to submitting their bids. No compensation will be made based on actual asphalt depths encountered.

2.2 MEASUREMENT FOR PAYMENT

2.2.1 Measurement shall be by square metre of each removed, including all sawcuts. No separate measurement for sawcutting of asphalt will be made.

2.3 BASIS OF PAYMENT

2.3.1 Payment at the Contract Price for the above referenced tender items shall be full compensation for all labour, equipment, and materials to do the work.

1 GENERAL

1.1 SCOPE

1.1.1 This specification covers the requirements for the installation of imported topsoil and sod.

1.2 REFERENCES

1.2.1 The requirements outlined in OPSS.MUNI 802 and OPSS.MUNI 803 shall apply to the installation of topsoil and sod.

2 PRODUCT

2.1 MATERIALS

2.1.1 Topsoil shall be imported.

3 EXECUTION

3.1 CONSTRUCTION

3.1.1 Topsoil shall be placed to a compacted uniform depth of 100mm on areas specified in the Contract Drawings and as directed by the Engineer. The Contractor shall excavate or fill to grades and elevations required for placement of the topsoil and sod to final elevations.

3.1.2 Sodding shall not commence until the surface preparation has been approved in writing by the Contract Administrator.

3.2 MEASUREMENT FOR PAYMENT

3.2.1 There will be no measurement for payment. Payment will be by lump sum for the installation of topsoil and sod.

3.3 BASIS OF PAYMENT

3.3.1 Payment at the Contract Price for the above tender items shall be full compensation for all labour, equipment, and materials to do the work.

DIVISION 3 – CONCRETE

Section No.	Title
03100	Concrete Forms and Accessories
03200	Concrete Reinforcement
03252	Waterstops
03300	Cast-in-Place Concrete
03410	Structural Precast Prestressed Concrete
03600	Grout
03612	Equipment Anchor Bolt Epoxy Grout

1 GENERAL

1.1 Scope of Work

1.1.1 Work supplied under this section includes the supply and installation of concrete formwork and falsework.

1.2 Related Sections

1.2.1 Section 03200 – Concrete Reinforcement

1.2.2 Section 03252 – Waterstops

1.2.3 Section 03300 – Cast-in-Place Concrete

1.3 Measurement and Payment

1.3.1 No measurement will be made under this section. Include costs in items of work for which concrete formwork and falsework is required.

1.4 References

1.4.1 Canadian Standards Association (CSA):

.1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete

.2 CSA O86-19 - Engineering Design in Wood

.3 CSA O121-17 - Douglas Fir Plywood

.4 CSA S269.1-16 (R2021)- Falsework and formwork

1.4.2 International Organization for Standardization

.1 ISO 16893 (2016) – Wood-Based Panels – Particleboard

1.5 DESIGN REQUIREMENTS

1.5.1 Design formwork in accordance with CSA S269.1, S269.2-M, and S269.3-M and CSA A 23.1-19 Clause 6.5 Formwork to provide specified finishes.

1.5.2 Design formwork and falsework to carry dead loads and construction live loads.

1.5.3 When high range water reducer (superplasticizer) is used in concrete mix, design forms for full hydrostatic pressure.

1.5.4 Make joints in forms watertight.

1.5.5 Design formwork to meet variations from a reference system specified in CSA A23.1-19 Clause 6.4 Construction Tolerances for Cast-in-Place Concrete.

1.6 Submittals

1.6.1 Make submittals in accordance with Section 01330 – Submittals.

1.6.2 Submit formwork and falsework drawings.

1.6.3 Submit both typical arrangements and specific configurations for each pour.

1.6.4 Show layout and dimensions of construction joints, drop beams, pipe encasements, and all other concrete edges in the structure.

1.6.5 Show layout of form liners, tie hole pattern and method of sealing form tie hole.

1.6.6 Show materials and layout of panels for formwork.

1.6.7 Show extent and layout of reglets, etc.

1.6.8 Comply with CSA-S269.1 for falsework and formwork drawings.

1.6.9 Show design loads, maximum allowable rate of pouring and material specifications.

1.6.10 Contractor to retain a Professional Engineer licensed in the Province of Ontario to sign and seal all formwork and falsework design and provide inspection during construction.

2 PRODUCTS

2.1 Materials

2.1.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CSA O86 and ISO 168693 Type P-HLB HMR.

2.1.2 Form ties:

.1 For concrete not designated ‘Architectural’, use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.2 All water/wastewater retaining structures ties are to have interior tie members that are cast into the structure complete with water stops and cone ends.

.3 All below grade structures ties are to have interior tie members that are cast into the structure complete with water stops and cone ends.

2.1.3 Form panels:

.1 Plywood: high density overlay Douglas Fir to CSA O121 No.1 grade, square edge, 20mm thick.

2.1.4 Form liner:

.1 Zemdrain® MD, Type III "Controlled Permeability Formliner" (CPF) as produced by Dupont, Maximum uses before discard: 3.

.2 Formtex® controlled permeability formliner (CPF) as produced by Fibertex® or Zemdrain® Classic, Type II CPF by Dupont. Maximum uses before discard: 1. This requirement will be strictly enforced.

2.1.5 Form release agent: non-toxic, biodegradable, low VOC.

2.1.6 Preformed joint filler: Ceramar flexible foam expansion joint filler by W.R. Meadows c/w joint cap.

3 EXECUTION

3.1 Fabrication and Erection

3.1.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

3.1.2 Locate construction joints at least 6m from any corner, and to limit the largest dimension of the pour to 15m.

3.1.3 Formliner (CPF) to be used on all vertical surfaces of all liquid-retaining structures and additionally andin all locations noted on the drawings. Apply CPF to liquid-retaining face of wall.

3.1.4 Apply Formliner (CPF) to surface of vertical forms with anchors spaced at not more than 400 mm c/c each way, and in strict accordance with the manufacturer's written instructions. Ensure the CPF is tight throughout as to avoid any indentations in the surface of the newly cast concrete.

3.1.5 Fabricate and erect formwork in accordance with CAN/CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations, and levels indicated within tolerances required by CAN/CSA A23.1/A23.2.

3.1.6 Align form joints and make watertight. Keep form joints to minimum.

3.1.7 Do not use form release agents on forms with CPF.

3.1.8 Use 25mm chamfer strips on external corners and/or 25 mm fillets at interior corners and joints, unless specified otherwise.

3.1.9 Form chases, slots, openings, drips, recesses, expansion, and control joints as indicated.

3.1.10 Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

3.1.11 Clean formwork in accordance with CAN/CSA A23.1/A23.2, before placing concrete.

3.2 Removal and Reshoring

3.2.1 Leave formwork in place for the following minimum periods of time after placing concrete.

.1 Seven (7) days for walls and sides of beams.

.2 Seven (7) days for beam soffits, slabs, decks and other structural members

.3 Four (4) days for columns.

.4 Two (2) days for footings and abutment.

.5 Contractor Note: Concrete requires additional curing after form removal. The ambient environmental conditions may require additional curing at the discretion of the Engineer.

3.2.2 After removing formwork, provide shoring under beams and suspended slabs for a minimum of 21 days.

3.2.3 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required

3.2.4 Re-use formwork and falsework subject to requirements of CAN/CSA A23.1/A23.2.

3.2.5 Follow all manufacturer's requirement and recommendations regarding reuse of the form liner.

3.2.6 The Zemdrain® MD Type III CPF may be used a maximum of three times before it <u>must</u> be replaced with a new liner. If CPF becomes torn or clogged, remove and replace immediately.

3.2.7 The Formtex® CPF or the Zemdrain® Classic CPF may only be used one time, without exception.

3.2.8 Totally remove any sections of liner which may have become embedded in the concrete and restore the surface at these locations to the approval of the Engineer

3.2.9 All concrete surfaces, including those with CPF, to be finished with a sack rubbed parge coat to the satisfaction of the Engineer. Refer to Section 03300 Cast in Place Concrete for concrete finish requirements.

END OF SECTION

1 GENERAL

1.1 Scope of Work

1.1.1 Work supplied under this section includes the supply and installation of concrete reinforcement.

1.2 Related Sections

1.2.1 Section 03100 – Concrete Forms and Accessories

1.2.2 Section 03300 – Cast-in-Place Concrete

1.2.3 Section 04220 – Concrete Masonry Unit

1.3 Measurement and Payment

1.3.1 No measurement will be made under this section. Include costs in items of concrete work for which reinforcement is required.

1.4 References

1.4.1 Canadian Standards Association (CSA):

.1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete

.2 CSA A23.3-19 - Design of Concrete Structures

.3 CAN/CSA G30.18-09 (R2019) - Carbon Steel Bars for Concrete Reinforcement

.4 CSA G40.20-13/G40.21-13 (R2018)- General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.5 CSA W186-21 - Welding of Reinforcing Bars in Reinforced Concrete Construction

1.4.2 American Concrete Institute (ACI):

.1 ACI SP-66 (04) - ACI Detailing Manual-2004

1.4.3 Reinforcing Steel Institute of Canada (RSIC):

.1 RSIC Manual of Standard Practice 2018

1.4.4 American Society for Testing and Materials (ASTM):

.1 ASTM A1064/A1064M-15 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

.2 ASTM A276/A276M-16 - Standard Specification for Stainless Steel Bars and Shapes

.3 ASTM A955/A955M-20c - Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement

.4 ASTM A775/A775M-07b (2014) - Standard Specification for Epoxy-Coated Steel Reinforcing Bars

1.5 Submittals

1.5.1 Samples and Product Data Sheets

.1 Submit three samples and three copies of manufacturer's product data sheets including installation and maintenance instructions for:

.1 Chairs, bolsters, bar supports, and side form spacers.

.2 Mechanical splices, mechanical threaded connectors.

1.5.2 Submit shop drawings in accordance with Section 01330 – Submittals.

1.5.3 Coordinate shop drawings with construction joint locations and pour schedules. Not all construction joints are shown on the drawings.

1.5.4 Indicate on shop drawings bar bending details, lists, quantities of reinforcement, sizes, spacing, locations of reinforcement and mechanical splices if approved by engineer, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacing and locations of chairs, spacers and hangers.

1.5.5 Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice – by Reinforcing Steel Institute of Canada.

1.5.6 Detail lap lengths and bar development lengths to CAN/CSA A23.3. Provide Type B tension lap splices, unless otherwise indicated.

1.5.7 Quality Control Submittals

.1 Submit certified mill test reports of steel reinforcing bars: Determine physical and chemical properties of steel reinforcing in accordance with requirements of CAN/CSA-G30.18-M.

.2 Dowel Bar Splicers (mechanical threaded connections):

.1 Current International Conference of Building Officials (ICBO) Research Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.

.2 Verification that device threads have been tested and meet requirements for thread quality, in accordance with manufacturer's published methods.

.3 Submit welding certificate in accordance with CSA W47.1 and CSA W186-M.

2 PRODUCTS

2.1 Materials

2.1.1 Substitute different size bars only if permitted in writing by Engineer.

2.1.2 Reinforcing steel: billet steel, grade 400R MPa, deformed bars to CAN/CSA G30.18, unless indicated otherwise. Use only one source for reinforcement supply.

2.1.3 Reinforcing stainless steel: billet steel, Type 316LN grade 420 MPa, deformed bars to ASTM A955.

2.1.4 Welded steel wire fabric: to ASTM A1064/A1064M. Provide in flat sheets only.

2.1.5 Chairs, bolsters, bar supports, spacers: continuous high chair type, Class C, D or E to CSA A23.1/A23.2.

2.1.6 Tie Wire

.1 Black, soft-annealed 1.6 mm diameter wire.

.2 Nylon-, epoxy-, or plastic-coated wire.

2.1.7 Mechanical splices: subject to approval of Engineer.

2.1.8 Plain round bars: to CAN/CSA G40.21.

2.1.9 Specification for epoxy-coated reinforcing bars: ASTM A775/A775M.

2.2 Fabrication

2.2.1 Fabricate reinforcing steel in accordance with CAN/CSA A23.1, ACI SP-66 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada, unless indicated otherwise.

2.2.2 Obtain Engineer's approval for locations of reinforcement splices other than those shown on placing drawings.

2.2.3 Upon approval of Engineer, weld reinforcement in accordance with CSA W186.

2.2.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

3 EXECUTION

3.1 Field Bending

3.1.1 Do not field bend or field weld reinforcement, except where authorized in writing by Engineer.

3.1.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

3.1.3 Replace bars that develop cracks or splits.

3.2 Placing Reinforcement

3.2.1 Survey and place string lines for face of concrete prior to placement of reinforcement cage and dowels. Maintain string line for engineer's inspection of dowels.

3.2.2 Use sufficient chairs and other supports to prevent movement of reinforcement during concrete placement.

3.2.3 Use of hooks to lift reinforcement during a slab pour are not permitted, all reinforcement is to be tied into position prior to placement of concrete.

3.2.4 Displacement of slab reinforcement to use as positioning bars under a slab cage is not permitted, provide continuous chairs under slabs.

3.2.5 Use of spreader bars and chairs are required to maintain wall steel in the proper position, reduction of the clear space between inside and outside cage is to be avoided.

3.2.6 Place reinforcing steel as indicated on the structural drawings, on reviewed placing drawings and in accordance with CSA A23.1.

3.2.7 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.

3.2.8 Prior to placing concrete, provide 72 hours' notice to Engineer and facilitate access for Engineer to review reinforcement placement. Make all necessary corrections before concrete is placed and allow re-inspection by Engineer, if requested.

3.2.9 Ensure specified concrete cover to reinforcement is maintained during concrete pour.

3.2.10 Touch-up damaged and cut ends of epoxy coated rebar with compatible finish to provide continuous coating.

3.2.11 Bend tie wire away from concrete surface. Ensure a cover for tie wires, form tie bolts etc. are same as the reinforcing bars. Do not let reinforcing tie wire touch formwork or be exposed in the finished concrete structure.

END OF SECTION

1 GENERAL

1.1 Section Includes

1.1.1 Provision of waterstops embedded in concrete and spanning control, expansion and/or construction joints to create a continuous diaphragm to prevent fluid migration.

1.2 References

1.2.1 CRD-C 572-74 – Corps of Engineers Specifications for Polyvinylchloride Waterstop

1.2.2 American Society for Testing and Materials (ASTM):

.1 ASTM D412-16 (2021) - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

.2 ASTM D570-22 - Standard Test Method for Water Absorption of Plastics

.3 ASTM D624-00 (2020) - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

.4 ASTM D638- - Standard Test Method for Tensile Properties of Plastics

.5 ASTM D746-20 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

.6 ASTM D747-10 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam

.7 ASTM D792-20 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

.8 ASTM D2240-15 (2021) - Standard Test Method or Rubber Property - Durometer Hardness

1.2.3 Bureau of Reclamation - C-902

1.3 Submittals

1.3.1 Make all submittals in accordance with Section 01330 – Submittals.

2 SUBMIT TECHNICAL DATA SHEETS FOR EACH TYPE AND PROFILE OF WATERSTOP AS WELL AS THE PREMANUFACTURED JOINT PIECES AND ANCILLARY PRODUCTS.

2.1.1 For PVC Waterstops:

.1 Identify all splices for waterstop
.2 Identify all field and shop splices
.3 Provide details of securing waterstop to reinforcing bar with carrier bars

2.1.2 Details of joint fillers, sealant, adhesives, and other appurtenances.

2.1.3 Samples:

.1 PVC water stop splice, joint, and fabricated cross of each size, shape, and fitting of water stop(s).

.2 Joint fillers.

2.2 Quality Assurance

2.2.1 Waterstop manufacturer shall demonstrate five (5) years (minimum) continuous, successful experience in production of waterstops.

2.2.2 Engage Manufacturer's Representative for on Site supervision during and after installation. Verify that specified products are correctly installed and comply with Manufacturer's printed instructions.

2.3 Delivery, Storage and Handling

2.3.1 Store waterstops under tarps to protect from oil, dirt, sunlight and premature exposure to water.

3 PRODUCTS

3.1 PVC Waterstops for Expansion Joints and Construction Joints

3.1.1 Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Sika Greenstreak, profile style number 696, or approved equal, for all expansion joints where indicated on structural drawings and for all expansion joints in water retaining structures and in underground structures .

3.1.2 Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Sika Greenstreak, profile style number 647, or approved equal, for all construction joints where indicated on structural drawings and for all construction joints in water retaining structures and in underground structures

3.1.3 The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.

3.1.4 Performance Requirements as follows:

Property	Test Method	Required Limits
Water Absorption	ASTM D570	0.15% maximum
Tear Resistance	ASTM D624	35 kN/m minimum
Ultimate Elongation	ASTM D638	350% minimum
Tensile Strength	ASTM D638	13.78 MPa minimum

Property	Test Method	Required Limits
Low Temperature Brittleness	ASTM D746	No Failure @ -37ºC
Stiffness in Flexure	ASTM D747	4.13 MPa minimum
Specific Gravity	ASTM D792	1.45 maximum
Hardness, Shore A	ASTM D2240	79 ± 3
Tensile Strength after accelerated extraction	CRD-C 572	11.03 MPa minimum
Elongation after accelerated extraction	CRD-C 572	300% minimum
Effect of Alkalies after seven (7) days: Weight Change Hardness Change	CRD-C 572	between -0.10% / +0.25% ±5 points

3.2 Hydrophilic Waterstop

3.2.1 Use hydrophilic waterstop only where specifically shown on design drawings. If no waterstop is shown, use PVC type waterstop by default.

3.2.2 Provide hydrophilic rubber waterstop as supplied by Multiurethanes or Sika, “Hydrotite” profile style number CJ-0725, or approved equal.

3.2.3 The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.

3.2.4 The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.

3.2.5 Performance Requirements as follows:

Chloroprene Rubber		
Property	**Test Method**	**Required Limits**
Tensile Strength	ASTM D412	9 MPa (1300 PSI) minimum
Ultimate Elongation	ASTM D412	400% minimum
Hardness (Shore A)	ASTM D2240	50 ± 5
Tear Resistance	ASTM D624	17.5 N/mm (100 lb/inch) minimum
Modified Chloroprene (Hydrophilic) Rubber		
Property	**Test Method**	**Required Limits**
Tensile Strength	ASTM D412	2.4 MPa (350 PSI) minimum
Ultimate Elongation	ASTM D412	600% minimum

Hardness (Shore A)	ASTM D2240	52 ± 5
Tear Resistance	ASTM D624	8.75 N/mm (50 lb/inch)
Expansion Ratio	Volumetric Change - Distilled Water @ 21ºC	3 to 1 minimum

3.3 Accessories

3.3.1 PVC Waterstops:

.1 Provide factory made waterstop fabrications for all changes of direction, intersections and transitions leaving only straight butt joint splices for the field.

.2 Provide hog rings or grommets along length of waterstop to hold the waterstop firm and in place. Space rings at 300mm on centre, unless spaced differently on structural drawings.

.3 Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.

3.3.2 Hydrophilic Waterstops:

.1 Provide “Sika Epoxy 7300” or approved equal to secure hydrophilic waterstop to rough, wet concrete.

.2 Provide “Leakmaster LV-Z, by Sika” single component hydrophilic sealant or approved equal to secure hydrophilic waterstop to rough, dry concrete.

.3 Provide cyanoacrylate adhesive (super glue) for all splices.

.4 Provide Leakmaster as addition to cyanoacrylate adhesive at all splices.

4 EXECUTION

4.1 Installation – PVC Waterstop

4.1.1 Install in all Expansion Joints and Construction Joints (unless noted otherwise):

4.1.2 Field splices are permitted provided that they are for straight butt splices only and shall be heat fused welded using a Teflon covered thermostatically controlled waterstop splicing iron at approximately 194ºC. Follow approved manufacturer recommendations, and provide training for any worker doing this work.

4.1.3 Lapping of waterstop, use of adhesives or solvents shall not be allowed.

4.1.4 Centre waterstop in joint and secure waterstop in correct position using hog rings or grommets along the length of the waterstop and wire tie to adjacent reinforcing steel. See structural drawings for details.

4.1.5

4.2 Installation - Hydrophilic Waterstop

4.2.1 Install Hydrophillic waterstop only where specified and keep dry until concrete encased. Waterstop that has been wetted prior to the pour will have to be replaced.

4.2.2 Cut coil ends square (or at proper angle for mitred corners) with shears or sharp blade to fit splices together without overlaps.

4.2.3 Splices shall be sealed using cyanoacrylate adhesive (super glue) and “Leakmaster LV-Z, by Sika” or approved equal.

4.2.4 Seal watertight any exposed cells of hydrophilic waterstop using “Leakmaster LV-Z, by Sika” or approved equal.

4.2.5 Follow approved manufacturer recommendations.

4.2.6 Hydrophilic waterstop must be installed on clean, dry, smooth, structurally sound concrete.

4.2.7 Clean concrete substrate of all dust, debris and laitance.

4.2.8 Remove the protective release tape and press the profile firmly onto the concrete substrate in the proper location. Do not reposition after initial contact with the concrete.

4.2.9 Hydrophilic waterstop applied to vertical or overhead surfaces shall be further secured with concrete nails spaced approximately 600 mm on centers.

4.2.10 Join lengths of the hydrophilic waterstop profile with cyanoacrylate (super glue) type adhesive. Joints to be dressed with a bead of “Leakmaster” Hydrophilic Caulk or approved equal. Intersections and changes of direction must be joined in a similar manner.

4.2.11 Installation temperatures above 4.5ºC are preferred. Low temperature installations (below 4.5ºC) require superficial heating of the concrete substrate immediately prior to the application of the hydrophilic waterstop profile. Carefully warm and dry the concrete surface with a hot air gun or propane torch and apply the hydrophilic waterstop profile while surface is still warm. Store the hydrophilic waterstop profile in a heated location until ready to install.

4.2.12 Adhesive performance may be affected by adverse storage conditions and time. Store in a cool, dry location and use within two (2) months of purchase.

4.2.13 After installations, protect hydrophilic waterstops from rain or snow.

4.3 Hydrophilic and PVC Intersections

4.3.1 Maintain continuity of waterstops at all intersections and transitions.

4.3.2 Joinery between PVC and hydrophilic waterstop shall include a 300mm overlap of the hydrophilic onto the PVC and be sealed using “Leakmaster LV-Z” by Sika or approved equal.

4.3.3 Follow approved manufacturer recommendations.

4.4 Field Quality Control

4.4.1 Waterstop splicing defects that are unacceptable include, but are not limited to, the following:

.1 Tensile strength less than 80 percent of parent section.

.2 Misalignment of centerbulb, ribs and bulbs greater than 5 mm.

.3 Bond failure at joint deeper than 1.5 mm or fifteen (15) percent of material thickness.

.4 Misalignment which reduces waterstop cross section more than fifteen (15) percent.

.5 Visible porosity in the weld.

.6 Bubbles or inadequate bonding.

.7 Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

.8 Charred or burnt material.

4.4.2 Hydrophilic defects that are unacceptable include, but are not limited to, the following:

.1 If it has been allowed to be wetted and expand prior to the concrete pour.

.2 Has become dislodged and is no longer in full contact with the existing concrete.

.3 Is placed outside of a reinforcement cage.

.4 Is discontinuous.

4.4.3 All defective waterstop must be removed and replace at no additional cost to the owner.

END OF SECTION

1 GENERAL

1.1 Scope of Work

1.1.1 Work supplied under this section includes the supply, testing and installation of cast-in-place concrete.

1.2 Related Sections

1.2.1 Section 03100 – Concrete Forms and Accessories

1.2.2 Section 03200 – Concrete Reinforcement

1.2.3 Section 03252 – Waterstops

1.2.4 Section 03600 – Grout

1.3 References (Latest Edition at the Time of Tender)

1.3.1 Ontario Building Code 2024National Building Code of Canada (NBC) 2020

1.3.2 Canadian Standards Association (CSA):

.1 CSA A23.1-19/A23.2-19 – Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete

.2 CSA A23.3-19 – Design of Concrete Structures

.3 CAN/CSA A3000-18 - Cementitious Materials Compendium

.4 CSA A23.2-21C-19 – Test Method for Length Change of Hardened Concrete

.5 CSA S900.2-21 – Structural Design of Wastewater Treatment Plants

1.3.3 American Concrete Institute (ACI):

.1 ACI 207.1R-05, Guide to Mass Concrete

.2 ACI 207.4R-05, Cooling and Insulating Systems for Mass Concrete

.3 ACI 214R-11 - Guide to Evaluation of Strength Test Results of Concrete

.4 ACI 237R-07 – Self Consolidating Concrete

.5 ACI 350-20 - Code Requirements for Environmental Engineering Concrete Structures and Commentary

.6 ACI 350.1-22 - Specification for Tightness Testing of Environmental Engineering Concrete Structures (SI)

.7 ACI 523.1R-06 – Guide for Cast-in-Place Low-Density Cellular Concrete

.8 ACI 304.2R Placing Concrete by Pumping Methods.

1.3.4 American National Steel Institute (ANSI) and National Sanitation Foundation (NSF):

.1 NSF/ANSI 61-2020 - Drinking Water System Components – Health

1.3.5 Ontario Water Resources Act

1.3.6 American Society for Testing and Materials (ASTM):

.1 ASTM C260/C260M-10a – Specification for Air-Entraining Admixtures for Concrete

.2 ASTM C309-19 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete

.3 ASTM C494/C494M-15 - Specification for Chemical Admixtures for Concrete

.4 ASTM C1017/C1017M-13e1 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

.5 ASTM C1611-21 – Standard Test Method for Slump Flow of Self-Consolidating Concrete

1.3.7 Concrete Ontario – Environmental Product Declaration, Concrete Ontario Member Industry-Wide EPD for Ready-Mixed Concrete.

1.3.8 ISO 14025:2006 – Environmental Labels and Declarations – Type III environmental declarations – Principles and Procedures

1.4 Measurement and Payment

1.4.1 The total volume of the Cast-in-Place concrete will not be measured and the work will be paid for at the price included in the Form of Tender for this section based on the percentage of the work completed.

1.4.2 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.

1.4.3 Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.

1.4.4 Coordination with other trades for the supply of hardware, pipe sleeves, and other embedded materials including the related layout drawing and installation will not be measured but considered incidental to work.

1.4.5 Supply and installation of waterstops, construction joints, and expansion joints will not be measured but considered incidental to work.

1.4.6 Repair of all cracks will not be measured but considered incidental to work.

1.4.7 Repair of any deficiencies in the concrete will not be measured but be considered incidental to work.

1.5 Quality Assurance

1.5.1 Performance of Concrete Mixes

.1 Concrete will be tested as identified in the mix performance part of this specification which includes Section 1.6.5 “Prequalification Test Results”, Section 1.6.6 “Trial Mixes” and Section 1.6.9 “Testing of Ready Mix Concrete”.

.2 Cracking of concrete in the structure is generally considered to be detrimental to the long-term performance. All cracks resulting in any visible leakage, and cracks greater than or equal to 0.3 mm must be repaired. Even though “low shrinkage concrete” is specified, cracking will occur and must be repaired by the Contractor at no cost to the Owner.

1.5.2 Concrete Production Facility

.1 The concrete production facility shall meet industry standard programs meeting plant and truck certifications with an ECO certification status in accordance with the RMCAO (Ready Mixed Concrete Association of Ontario).

1.6 Submittals

1.6.1 All submittals to conform with Section 01330.

1.6.2 Submit a current, valid Certificate of Ready Mixed Concrete Production Facilities as issued by RMCAO for plants supplying concrete to the Contract.

1.6.3 Submit certification that ready mix concrete manufacturer has current qualification for RMCAO Seal of Special Quality Concrete.

1.6.4 Certification of Materials and Concrete Producer statements identifying the sources and certifying:

.1 Cement types, sources, and conformance to CSA A23.1/A23.2 and CAN/CSA-A3000

.2 Aggregates comply with CSA A23.1/A23.2 and are from M.T.O. designated sources list; submit gradations.

.3 Admixture product names and certification that they comply with CSA A23.1/A23.2 and ASTM C260, ASTM C494/C494M, or ASTM C1017/ C1017M. State type or class of admixture.

.4 Materials, plant, and equipment to be used in concrete work comply with the requirements of CSA A23.1/A23.2.

.5 Compliance with Ontario Water Resources Act with respect to toxicity.

.6 Proposed mix designs including complete details of product additives and certification that all additives are compatible with all other additives.

1.6.5 Prequalification Test Results

.1 Submit prequalification test results to the Engineer for each Ready-Mix Concrete Mix proposed, showing adequate performance for:

.1 Compressive strength
.2 The standard deviation for the concrete compressive strength tests in conformance with ACI 214R.
.3 Linear shrinkage
.4 Air entrainment

.2 Prequalification tests must have occurred within three (3) months of the first concrete pour or they will not be considered valid.

.3 Submit test results from each trial mix confirming concrete strength, air-content and linear shrinkage. Submit one (1) linear shrinkage test result for structural concrete mix for all HPC mixes. Linear shrinkage tests must be current to within three (3) months of project commencement. The tested concrete must contain all materials that will be supplied to the site and be from the batch plant that will supply the site.

.4 Adjust mixes that do not provide adequate performance, retest and resubmit the test results as noted above.

1.6.6 Trial Mixes

.1 Prior to the start of on-site concrete construction of any structure, prepare trial mixes of each structural concrete mix design to confirm the mix-design satisfies the performance and workability requirements. The test for the workability of the mix must involve a full truckload of the proposed concrete mix, transported from the truck, placed and consolidated in an area of the Contractor's choosing, using the proposed conveyance system. Trial mixes and related workability proof testing must have occurred within three (3) months of the first concrete pour or they will not be considered valid.

.2 Trial mixes will be tested for slump, concrete strength, air-content, wet cast density and linear shrinkage by an independent testing agency arranged by the Owner.

1.6.7 After review and acceptance of the mix designs, supply concrete in accordance with the reviewed mixes.

1.6.8 Concrete Work Plan

.1 Prior to the start of on-site concrete construction, prepare a concrete work plan in accordance with the requirements in section 3.2.1.4 and 3.2.2.2, including concrete mix production, concrete placing procedures and casting sequence, and curing and protection procedures.

.2 For mass concrete placement, provide a thermal control plan following requirements of CSA A23.1 clause 7.6.3.4.

.3 Submit the work plan to the Consulting Engineer for approval at least 10 days prior to the pre-construction concrete meeting as outlined in clause 3.2.1.

1.6.9 Testing of Ready Mix Concrete

.1 Testing will be performed by an independent testing agency arranged by the Owner.

.2 Testing of Ready Mix Concrete trucks on delivery will include:

.1 Slump
.2 Air content
.3 Concrete temperature
.4 Wet cast density

.3 Samples will be cast for laboratory testing for:

.1 Compressive strength
.2 Linear shrinkage as requested by the Engineer.

.4 Initially 3, 7, 14, and 2-28 day cylinder samples (one set) will be taken and tested. However, upon achieving acceptable results the testing will be reduced to 7, 14 and 2-28 day tests. Where design strengths are based on 56 days, 7, 28, 2-56 day cylinder samples are required. If the amount placed, for each type of concrete is less than 100 m^3 in a day, provide concrete for one standard strength test.

.5 Linear Shrinkage Tests

Provide linear shrinkage tests for every 1000 m^3 of concrete used on the project to ensure conformity to approved mix designs.

.5 Provide linear shrinkage tests for any pour greater than 150 m^3.Concrete slump, air, and temperature shall be tested once per pour or once every 50 m^3, whichever is more frequent.

.6 Additional samples may be taken for other testing as determined by the Engineer.

.7 Copies of all concrete testing carried out by the Engineer will be made available to the Contractor upon request.

.8 The use of testing services does not relieve the Contractor of the responsibility to furnish materials and construction in compliance with the performance requirements of the contract documents.

.9 The Contractor shall take samples and carry out testing as part of their quality control procedures to verify that the concrete satisfies the performance requirements set out in these specifications. Where possible, these tests shall be carried out on the same batches as tested by the independent testing agency.

.10 Copies of the test results for all tests carried out by the Contractor must be made available to the Engineer for review and records.

2 PRODUCTS

2.1 Materials for Concrete Mixes

2.1.1 Use materials conforming to CSA A23.1/A23.2, and to the performance requirements which have been established in this section.

2.1.2 Cement

.1 Normal Portland Cement (Type GU) blended with cementitious slag. Use Portland cement and Slag cement conforming to CSA A3000 and comply to the following conditions and requirements:

.1 For structural and architectural concrete mixes, the supplier may incorporate cementitious slag into the proposed mix design as a replacement for up to 50 percent by mass of the quantity of Type GU Portland cement.
.2 For lean concrete, slag cannot be used to replace any of the Portland cement.
.3 For mass concrete, HVSCM concrete may be used.

2.1.3 Water

.1 Use only potable water in all concrete mixes.

2.1.4 Additives

.1 Conform to CSA A23.1/A23.2 and ASTM C260, ASTM C494/C494M, State type or class of admixture.

.2 Use admixtures from one manufacturer and satisfy the intent and, where practical, the specific recommendations of that manufacturer.

.3 Ensure admixtures are compatible with each other and with any construction materials used that will be in contact with concrete. Ensure that the mix remains workable with the inclusion of such admixtures.

.4 Do not use calcium chloride nor admixtures containing chlorides.

.5 Shrinkage Reducing Admixture (not covered by CSA or ASTM standards).

.1 A shrinkage reducing admixture shall be used in all topping mixes and in elements with thickness of 125 mm or less.
.2 A shrinkage compensating admixture may be used where appropriate or as necessary to meet linear shrinkage testing requirements specified herein.

2.1.5 Aggregate

.1 Starter grout wall mixes to be placed at the bottom all large wall pours to have no large aggregate.

.2 All mixes for concrete elements with thicknesses of 125 mm or less shall contain 14 mm aggregate.

.3 Mixes for mass concrete may contain aggregate sizes up to 40 mm.

.4 Use 20 mm aggregate in the remainder of the mixes, unless approved or otherwise specified by the Engineer.

2.2 Concrete Mixes

2.2.1 Supply concrete to meet the project performance requirements. Structural Concrete specified herein is required to be “High Performance Concrete” for increased durability and watertightness, and reduced shrinkage and cracking, compared to regular structural concrete.

2.2.2 The high performance concrete mix shall be manufactured under the requirements of Clause 8.8 “Low Shrinkage Concrete” of CSA A23.1/A23.2 which include a shrinkage limit of 0.04% based on modified CSA A23.2-21C.

2.2.3 This is considered to be a Performance Specification in accordance with CSA A23.1/A23.2 - Table 5 Alternative Methods for Specifying Concrete.

2.2.4 Lightweight concrete mix shall be manufactured in accordance with ACI 523.1R.

2.2.5 Meet or exceed the requirements in the following tables:

Mix Number	**1**	**2**	**3**	
Mix Description	Slabs, walls, columns and beams	Grout for starting structural walls & columns	Toppings, screeds, benching for tankage, int./ext. floors or roofs & thin concrete sections	
Special Performance	HPC – Low Shrinkage		HPC – Low Shrinkage	
Min. Specified Strength, 28 days	35 MPa	35 MPa	35 MPa	
Max. Aggregate Size	20mm	N/A	14mm	
Slump Range (see 2.2.7)	120-180	120-180	-	
SCM	Max. 50% slag	Max. 50% slag	Max. 50% slag	
Max. W/C Ratio	0.40	0.40	0.40	
CSA Exposure Class	A-1	A-1	A-1	
Plastic Air Range (%)	5-8	-	5-8	
Additives	Super plasticizer admixture	Super plasticizer admixture	Super plasticizer admixture, and shrinkage reducing admixture	

Mix Number		**6**			**9**	**10**
Mix Description		Mud slabs, & fill concrete			Mass concrete	U-Fill for pipe bedding and backfilling
Special Performance		-			Low heat of hydration	-
Min. Specified Strength @ 28 days		20 MPa			-	0.4MPa max. as per OPSS. MUNI 1359
Min. Specified Strength, 56 days		-			30 MPa	-
Max. Aggregate Size		14mm			40mm	-
Slump Range					120-180	Min 150 mm
SCM	n	-			Max 75% slag	-
Max. W/C Ratio		0.5			0.5	-
CSA Exposure Class		N			F-1	-
Plastic Air Range (%)		-			4-7	-
Additives		-			Super plasticizer, set retarder	-

2.2.6 HPC herein means high performance concrete with reduced shrinkage, reduced cracking and increased durability.

2.2.7 Final selection of slump for each mix is the responsibility of the contractor to suit specific site needs for workability and finishing.

2.2.8 Super plasticizer admixture to be added to the mix at the batching plant. Additional superplasticizer may be added on site to meet the workability requirements of the Contractor placing the concrete in accordance with the manufacturers published recommendations.

2.2.9 For mass concrete, proportion mix to reduce the heat of hydration. When HVSCM concrete is used, follow the requirements of this specification and CSA A23.1/A23.2, whichever is more stringent.

2.2.10 Utilize the same mix proportions throughout the project.

2.2.11 Where the performance of a mix deteriorates to values below the Contract requirements, cease supply of the mix. Re-evaluate the mix, propose revised proportions to meet the performance requirements for the mix, submit trial mix results, and after review, utilize the revised mix.

2.3 Materials for Crack Injections

2.3.1 Epoxy Grout Injection

.1 All epoxy used must comply to the NSF/ANSI 61 requirements for use in potable water unless otherwise specified or approved by the Engineer. Acceptable products include:

.1 Sikadur 35 Hi-Mod LV
.2 Sikadur 52
.3 MasterInject 1500, by BASF Master Builders Solutions
.4 or an approved equal

2.3.2 Flexible Polyurethane Grout Injection

.1 For non-potable water, acceptable products include:

.1 Sika Fix PU LV
.2 Sika Fix PU
.3 MasterInject 1210 IUG, by BASF Master Builders Solutions
.4 or an approved equal

.2 For potable water, NSF/ANSI 61 accepted products include:

.1 Sika Fix HH LV
.2 Multiurethanes – Flexible Resin
.3 MasterInject 1230 IUG, by BASF Master Builders Solutions
.4 or an approved equal

.3 Polyurethane Sealant

.1 Sikaflex 2C NS, NSF/ANSI 61 approved
.2 MasterSeal NP2, by BASF Master Builders Solutions
.3 or an approved equal

2.3.3 No crack injections shall be carried out without the approval of the Engineer.

2.4 Polyethylene Sheets

2.4.1 Polyethylene Slip Sheet – 15 mil polyethylene sheet satisfying ASTM E1745 CLASS ‘A’.

2.4.2 Dampproof Membrane – See section 07120

2.4.3 Curing Membrane – 6 mil polyethylene sheet

2.4.4 Curing Compounds - The curing compound, if permitted by the engineer, shall conform to the requirements of ASTM C309. NSF/ANSI 61 approved materials where in contact with potable water.

2.5 Miscellaneous Materials for Joints

2.5.1 Preformed Joint Fillers – See Section 03100.

2.5.2 Bond Breakers - 810-07 Non-Fibered Asphalt Roof and Foundation Coating by Henry Company Canada Inc.

2.5.3 Saw-cut joint Control Joint Sealants for Slab on grade - Epoxy modified joint sealant, cold-applied, 2-component, pour grade, self-levelling compound with minimum Shore A Hardness of 80 and Shore D Hardness of 50. Acceptable Products include:

.1 Sika Loadflex by Sika Canada Inc.

.2 Cipadam E-13 Load Bearing Control Joint Filler by CPD Construction Products.

.3 Rezi-Weld Flex, Semi-Rigid Epoxy Joint Filler by W.R. Meadows of Canada Ltd.

.4 MM-80 Semi-Rigid Epoxy Joint Filler by Metzger/McGuire.

.5 Euco 700 by The Euclid Chemical Company (Euclid Canada), a division RPM, Inc.

.6 Sonneborn brand, Epolith P by BASF – Building Systems

2.5.4 Expansion joint sealant – SikaFlex 2C NS or approved equivalent.

2.5.5 Bonding Agent - SikaTop Armatec110 EpoCem or approved equivalent.

2.6 Temperature monitoring equipment

2.6.1 Temperature monitoring equipment shall provide continuous temperature monitoring.

2.6.2 Real-time monitoring data shall be made available to consultant and contractor.

2.6.3 Monitoring temperatures shall be directly recorded and sent to the monitoring manufacturer program where reports are being generated.

2.6.4 User-friendly mobile app or computer interface shall be provided with location of sensors clearly identified at the interface.

2.6.5 Data logs shall be available for downloading as PDFs for record keeping.

3 EXECUTION

3.1 Standard of Workmanship

3.1.1 Comply with CSA A23.1/A23.2.

3.1.2 Undertake all aspects of the Work to meet watertight requirements.

3.2 Preparation

3.2.1 Preconstruction Concrete Meeting

.1 Prior to concrete construction, hold a meeting to discuss all design requirements and any potential production or construction issues to avoid delays during the implementation of the works.

.2 Have representatives of every party involved in the concrete work attend the meeting, including but not limited to the following:

.1 Contractor's superintendent
.2 Concrete subcontractor's Foreman and Cement Finisher
.3 Ready-mix concrete producer
.4 Admixture manufacturer(s)
.5 Laboratory responsible for the concrete design mixes and trial mixes
.6 Concrete pumping subcontractor, if applicable

.3 The representative of the Owner, the Engineer and the Independent Laboratory responsible for field quality control will also attend the meeting. Coordinate with the Engineer at least 10 days prior to the scheduled date of the meeting.

.4 Provide a description of the intended procedures and Quality Assurance for:

.1 Concrete mix production, delivery and discharge
.2 Concrete mix testing including storage facilities provided by the Contractor and procedures
.3 Formwork construction and alignment
.4 Installation of Formliners and waterstops
.5 Concrete handling, pumping, and placement
.6 Concrete finishing
.7 Curing procedures
.8 Concrete protection in hot, cold or windy weather
.9 Watertightness
.10 Mass concrete procedures

.5 Ensure that each party's interests are discussed, and procedures refined to provide optimum concreting practices for this project.

.6 Distribute minutes of the meeting to all parties present and with related individuals within five (5) days of the meeting.

.7 Ensure that procedures established and agreed at this meeting are carried out during construction.

.8 If additional procedures are required, meet again, discuss, develop, submit and follow the revised procedures.

3.2.2 Pre-planning Requirements

.1 Two weeks (14 calendar days) prior to placing of concrete, obtain Engineer's approval of the proposed method for the protection of the concrete during placing and curing.

.2 Submit the proposed sequence of casting for review by the Engineer including the location of the proposed construction joints. Where possible sequence the casting schedule so that walls are cast as soon as possible after their supporting footings or slabs are cast.

.3 Complete and submit the Concrete Pour Release Form prior to placing any concrete.

.4 Provide three (3) working days' notice of the proposed time of commencing of concrete placement. The Contractor will be responsible for the Engineer's testing companies standby time costs in the event a concrete pour does not commence within 90 minutes of the proposed time indicated in the three (3) day notice.

.5 Ensure reinforcement and inserts are not disturbed during concrete placement.

.6 Coordinate with the concrete supplier with respect to the workability requirements for the concrete. Do not add water to the concrete after the initial batching unless approved by the Engineer, and the concrete supplier. If approval is granted, a record of the amount of water added must be kept and a copy submitted to the Engineer within three (3) days for their records.

.7 Establish and maintain accurate records of poured concrete items to indicate date, location and size of pour, air temperature, concrete temperature, previously placed concrete temperature, batch ticket and test samples taken.

.8 Do not place load upon new concrete until authorized by the Engineer.

3.3 Summer Concreting

3.3.1 Between June 1st and September 30th, except when the air temperature is below 3ºC and winter concrete requirements dictate, the Contractor must prepare and submit their procedures for curing the concrete based on and to suit the ambient conditions anticipated during the curing period. Most cracking is a result of excessive water content in the concrete, rapid drying and thermal effects that including thermal shock during or shortly after the removal of the formwork, ambient conditions or shape considerations. The requirements are designed to minimize those effects and, thereby, to minimize the cracking of the concrete.

3.3.2 The maximum temperature of the concrete delivered to the site must be maintained at or below 26ºC. This may require the addition of ice to the mix at the Ready Mix Concrete Plant. An amount of water, equivalent to the volume of the ice, must be removed from the mixing water.

3.3.3 For each pour exceeding 20 m^3 provide and install temperature probes to measure the temperature of the concrete. The probes must be installed to measure the temperature of the concrete, 150 mm below the surface, at two (2) locations for each day of placement or type of concrete, locations to be established by the Engineer. These probes shall be used to measure the temperature of the concrete prior to the removal of the forms. In addition, the probes shall be maintained to establish the temperature of that concrete when new concrete is placed against it. The probes must be of a type that will record the temperature continuously and will allow for the downloading of that data.

3.3.4 For formed structures: The forms for walls, columns and related structures and for suspended slabs shall remain in place for a minimum period of seven (7) days after placing the concrete. If the temperature differential between the concrete and the ambient air is

greater than 10ºC, the forms shall remain in place until the temperature differential is less than 10ºC. Immediately after the removal of a form, the concrete shall be thoroughly wetted down and be covered with a 6 mil polyethylene sheet or equivalent and this sheet shall remain in place for a minimum of seven (7) days.

3.3.5 For slabs: Slabs must be misted during the placing and finishing work. After the finishing has been completed, the slab must be flooded and be covered completely with tarpaulins for seven (7) days. When temperatures are above 30ºC the slab must be covered for a total of 14 days.

3.3.6 The surface of slabs, against which new concrete is to be placed, shall be cooled using intermittent wetting techniques and the temperature shall not be more than 5ºC greater than the new concrete at the time of placing the new concrete.

3.3.7 The use of curing compounds is not to be considered normal practice and the use will be at the discretion of the Engineer. Curing compound shall be applied immediately after the removal of the forms for walls and similar structures. In addition, its use may be considered for slabs after the initial seven (7) day curing period has been completed.

3.4 Winter Concreting

3.4.1 Between October 1st and May 31st of the following year, and at any time when the air temperature is below 3ºC, or when, in the opinion of the Engineer, there is a probability of its falling to that limit during the placing period, place concrete in accordance with the requirements of CSA A23.1/A23.2, “Cold Weather Requirements”.

3.4.2 The temperature of the concrete, when deposited, shall not be less than 10ºC and not more than 25ºC. To accomplish this, the mixing water and, if necessary, the aggregates, shall be heated. Aggregates shall not be heated above 85ºC.

3.4.3 For each pour exceeding 20m^3 provide and install temperature probes to measure the temperature of the concrete. The probes must be installed to measure the temperature of the concrete 150 mm below the surface at two (2) locations per day of placement and type of concrete, locations to be established by the Engineer. These probes shall be used to measure the temperature of the concrete prior to the removal of the forms. In addition, the probes shall be maintained to establish the temperature of that concrete when new concrete is placed against it. The probes must be of a type that will record the temperature continuously and will allow for the downloading of that data by the Engineer.

3.4.4 The temperature difference between concrete being placed and the concrete against which it is placed is of primary importance during winter concreting. The temperature of the base concrete, measured 150 mm below the contact surface, must be within 5ºC of the concrete being placed against it, but no lower than 5ºC. The Contractor, to satisfy this requirement, must provide a 5000 mm wide underslab heating system. This system must:

.1 Be continuous along the full length of the wall.

.2 Heat the slab from bottom up.

.3 Include insulated tarpaulin placed on the slab over the area which is to be heated.

.4 Meet the above temperature requirements before the new concrete is placed.

.5 Be left in operation for at least 72 hours after the new concrete has been placed.

.6 Include the insulated tarpaulins being left in place over the heated area until the forms are removed.

3.4.5 If uninsulated metal forms are to be used or if the temperature within the form falls below -5ºC prior to placing the concrete, an insulated cover must be provided over the formwork and heat must be provided to raise the temperature to +5ºC before pouring the concrete. All snow or ice must be removed from the form prior to placing the concrete. Insulated cover and heat must remain in place for the cure period.

3.4.6 The forms for walls, columns and suspended slabs shall remain in place for a minimum for seven (7) days after placing the concrete. Additional protection is to be provided as per 3.4.7.

3.4.7 The temperature of the concrete shall be monitored and when the form is to be removed, the temperature differential between the concrete and the ambient conditions shall be recorded and:

.1 If the temperature differential is less than 10ºC and the winds is less than 20 km/h, the forms must be left on for seven (7) days and when they are removed, the concrete must be covered tightly with a 10 mil polyethylene sheet or suitable new tarpaulin. The covering must remain in place for a minimum of seven (7) days.

.2 If the temperature differential is 10ºC or greater, the forms cannot be removed. Once the temperature differential is less than 10ºC follow clause 3.4.7.1.

3.4.8 If an enclosure is required to meet the requirements of clauses 3.4.1 through 3.4.7, provide an enclosure.

.1 The enclosure shall be kept between 10ºC and 18ºC for a minimum period of seven (7) days after placing the concrete. The temperature shall be gradually reduced at the end of the period of protection at a rate not greater than 10ºC per day until the outside ambient temperature is reached.

.2 Combustion type heaters may be used but they shall be constructed and placed so that their combustion gases are not directed toward the surfaces of the “green” concrete.

3.4.9 Slip forming: curing and form removal in accordance with CSA A23.1/A23.2 for curing type 2.

3.5 Mass Concrete:

3.5.1 Permissible concrete temperature at placement shall follow the limits indicated in Table 14 of CSA A23.1.

3.5.2 In summer months, the concrete temperature at placement shall not be less than 10ºC and not more than 15ºC.

3.5.3 Provide and install two (2) temperature probes to measure the temperature of the concrete per pour for base slabs. One probe to be locate at 75 mm from the surface and the other to be located at the mid-depth of the concrete thickness at locations established by the Engineer. These probes shall be used to measure the temperature differential between the concrete core and the near surface and limit the maximum differential following CSA A23.1 clause 7.6.3.2. Provide additional pairs of temperature probes such that the spacing does

not exceed more than 10.0 m each way. For walls, provide three (3) temperature probes at each location (inside face, outside face and mid-depth).

3.5.4 The installed temperature probes shall also be used to measure the temperature of the concrete prior to the removal of the forms. In addition, the probes shall be maintained to establish the temperature of that concrete when new concrete is placed against it. The probes must be of a type that will record the temperature continuously and will allow for the downloading of that data by the Engineer.

3.5.5 Once surface is finished, provide and install insulated tarpaulins to completely cover and seal the mass concrete pour. Maintain moisture on surface with a soaker hose and burlap under the insulated tarpaulins.

3.5.6 Insulated tarpaulins are to remain in place for a minimum of seven (7) days after placing the concrete. If the temperature differential between the concrete, taken from the probes, and the atmospheric air temperature is greater than 5ºC, the forms and insulated tarps shall remain in place until the temperature differential is less than 5ºC.

3.6 Vibrators

3.6.1 The use of mechanical vibrators is required for all structural concrete.

3.6.2 A sufficient number of vibrators shall be employed so complete compaction is ensured.

3.6.3 At least one (1) extra gasoline powered vibrator shall be on hand for emergency use.

3.6.4 Vibration shall not be continued to the extent that water forms on the surface.

3.6.5 Avoid any disturbance to concrete that has become too stiff to regain plasticity when vibrated.

3.6.6 Vibration shall not be applied directly to steel which extends into partially hardened concrete.

3.7 Construction

3.7.1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.

3.7.2 At construction joints, all loose debris/items must be removed/cleaned and laitance must be mechanically removed from the face of concrete from previous castings and the joint shall be saturated surface dry before adjacent concrete is placed.

3.7.3 Sleeves and Inserts:

.1 No sleeves, ducts, pipes, or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by the Engineer.

.2 Where approved by the Engineer, set sleeves, ties, pipe hangers, and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 mm x 100 mm not indicated, must be approved by the Engineer.

.3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from the Engineer before placing of concrete.

.4 Check locations and sizes of sleeves and openings shown on drawings.

.5 Sleeves and openings shall be placed at a minimum of three sleeve diameters centre to centre unless noted otherwise.

.6 Box out for penetrations are not permitted, unless agreed to in writing from the Engineer. . If requested by the contractor, additional reinforcement and waterstops will be required to compensate for the construction of the box out. Supply and install of these additional reinforcements and waterstops shall be at no additional cost to the Owner.

3.7.4 Anchor Rods:

.1 Set anchor rods to templates under supervision of appropriate trade prior to placing concrete.

.2 Protect anchor rod holes from water accumulations, snow, and ice build-ups.

.3 When using proprietary anchor systems set rods and fill holes with epoxy grout, in accordance with the manufacturer's requirements. All proprietary anchors must be approved by the Engineer.

.4 Locate anchor rods used in connection with expansion shoes, rollers, and rockers with due regard to ambient temperature at time of erection.

.5 Under special circumstances, with approval of the Engineer, grouted anchor rods may be installed into preformed holes or holes drilled after concrete has set. Formed holes or sleeves to be minimum 100 mm diameter and be deformed.

3.7.5 Drainage Holes and Weep Holes:

.1 Form weep holes and drainage holes in accordance with Section 03100 – Concrete Forms and Accessories. If wood forms are used, remove them after concrete has set.

.2 Install weep hole tubes and drains as indicated.

3.7.6 Coordination:

.1 Adjust the work to suit final shop drawings of the equipment being supplied. Verify all sizes with the trade supplying and installing the equipment. Obtain, utilize and submit data on relevant sizes to suit any change in equipment. Confirm the adjustments with the Engineer.

3.7.7 Grouting:

.1 Grout to be placed in accordance with grout specification section 03600. Grout under base plates and/or machinery using procedures in accordance with manufacturer's recommendations that result in 100 percent contact over grouted area. Install bleed holes in base plates to ensure full coverage of grout.

3.7.8 Slip-Sheet:

.1 Install polyethylene slip-sheet under mud-slab for all the concrete slabs cast against grade as indicated on the drawings.

.2 Lap slip-sheet a minimum of 300 mm at joints and seal.

.3 Seal punctures in slip sheet before placing concrete. Use patching material at least 300 mm larger than puncture and seal.

3.7.9 Curing Compounds – Dependant on the location and situation, the use of curing compounds may be approved by the engineer.

.1 Starter Walls:

Deposit 100 mm of wall and column grout evenly along horizontal construction joints in bottom of form through an elephant trunk immediately before placing wall or column concrete.

3.8 Finishes

3.8.1 Formed finishes specified herein shall be finished as defined by CSA A23.1/A23.2.

.1 The surfaces exposed to view shall be given a smooth form finish with sack-rubbed finish.

.2 Interior surfaces of tanks including the portion of those structures above the high water level to the top of the structure, shall be given a smooth form finish with a “sack-rubbed” finish.

.3 All buried surfaces shall be given a rough form finish. All buried surfaces that receive water proofing or damp proofing to have all voids and bugholes filled.

.4 In type C-1, A-1 and A-2 type concrete all bugholes shall be filled.

.5 All exposed and non-exposed corners shall be rubbed with a carborundum stone to remove any loose concrete fins and edges and to create a smooth and rounded profile.

3.8.2 Unformed surfaces shall be finished as defined by CSA A23.1/A23.2.

.1 The floor surface of occupied spaces shall be “floated” and “trowelled” to create a Class A Floor finish as defined by Table 21 in CSA A23.1/A23.2.

.3 The floor surface of exterior or interior walkways and tankage or chambers, shall be “swirl trowelled” to create a non-slip surface.

.4 All tops of buried structures and foundations shall be finished by steel float to a sealed smooth surface.

.5 All surfaces to receive waterproofing membrane shall be finished as per manufacturers recommendations.

.6 All surfaces to receive epoxy coating shall be prepared as per epoxy manufacturer's recommendation.

3.9 Examination of Completed Structures

3.9.1 Undertake, with the Engineer, review of concrete surfaces for defects and finishes.

3.9.2 Undertake, with the Engineer, assessments and measurements of the concrete structures for cracking.

3.9.3 Provide a written summary of defects noted complete with a plan showing locations of each defect.

3.9.4 Submit a plan for repair of each defect in accordance with these specifications.

3.9.5 Undertake, with the Engineer, to test all liquid containing structures for watertightness in accordance with applicable standards.

3.9.6 Test for water tightness in accordance with ACI 350.1. All chambers, channels, and tanks to be tested separately as open containment structures classified as "Other types".

3.9.7 Submit a leak test plan for each type of liquid containing structures.

3.9.8 Leak test duration requirements shall be based on part 1 and 2 of the test, refer to ACI 350.1 Section 1 and Section 2 for more information.

3.9.9 Completed concrete tank may be leak tested when the specified compressive strength has been reached and/or when the age of the last concrete pour is minimum 14 days old, whichever is the longest.

3.9.10 Failure to Meet Strength, Air Content, or Workability Requirements

.1 When measured workability or air content falls outside of required limits, carry out a check test immediately on another portion of the same sample. In the event of a second failure, the concrete will be considered to have failed to meet the requirements. Remove the whole batch, from which the samples were taken, off the site.

.2 When the strength requirement provisions are not met, carry out one or more of the alternatives of CSA A23.1, Clause 4.4.6.7 - Failure of Standard Cured Cylinder Test Results to Meet Requirements.

.3 When, after carrying out these requirements, there is still doubt about of the adequacy of the concrete, strengthen or replace, as directed, portions of the Work which failed to develop the required strength.

3.9.11 Uniformity of Mixed Concrete

.1 If the results of workability, air content or density for any mix design do not comply with CSA A23.1, Table 13 - Determination of Within-Batch Uniformity, alter mixing operations and equipment until tests indicate that the requirements are satisfied.

3.9.12 Concrete Delivery Records

.1 Submit with each batch of concrete before unloading, a typed delivery ticket prepared at the ready mix plant containing following information:

.1 Name of ready-mix batch plant.
.2 Serial number of ticket.
.3 Date and truck number.
.4 Name of the Contractor.
.5 Name of Job.
.6 Specified 28-day strength of concrete with identifying mix number.

3.10 Patching or Repairs

3.10.1 No patching or repairing shall be carried out without the approval of the Engineer.

3.10.2 All preparation for repairs is to be reviewed by the engineer.

3.10.3 All patches, bug holes, and suspected honeycomb are to be reviewed by the engineer prior to patching.

3.10.4 All repairs shall be colour matched to the parent concrete.

3.10.6 Surface defects such as honeycombing, sand streaking, lift lines, variations in colour, soft areas, and large surface voids in the finished concrete walls shall be considered defective and shall be repaired by the contractor at no additional cost to the Owner, regardless of structural or water retaining characteristics of the wall. Provide a methodology to repair all visible pour lines, for submission and approval by the Consultant.

3.10.7 All bug holes to be filled for concrete mixes with exposure classes of C-1, A-1 and A-2 at no additional cost to the Owner.

3.10.8 All honeycombing shall be chipped out to sound concrete. The edge around the perimeter of the area shall be sawcut to a depth of 20 mm minimum to eliminate all “feather” edges. All repairs of honeycomb shall be a proprietary repair material. If honeycombing extends to the depth of the reinforcement, the chipping shall be continued to a depth of 1.4 times the diameter of the largest reinforcing bar and 40 mm minimum beyond the layer of reinforcement.

3.10.9 The patch shall be continuously covered with a 6 mil polyethylene sheet and heated to above 15ºC for 14 days.

3.10.10 Chips and edge breaks in the concrete shall be repaired as noted above.

3.10.11 All visible cracks in liquid retaining structures shall be repaired. Submit a detailed plan and details for review by Engineer before beginning any repair or injection. As the standard repair methodology, unless otherwise approved by the Engineer, cracks shall be injected with epoxy or polyurethane, depending on the application. Clean face of concrete after injection is complete.

3.10.12 Prior to the leak test all visible cracks are to be repaired by epoxy injection.

3.10.13 During the leak test, minor visibly leaking cracks may be repaired with polyurethane grout upon approval of the Engineer.

3.10.14 In the event that injection cannot seal the leak, with the approval of the Engineer, the crack shall:

.1 be routed out square to a depth and width of 20 mm

.2 be thoroughly cleaned

.3 have a bond breaker placed in the bottom of the routed slot

.4 be primed in accordance with the manufacturers recommendations

.5 be sealed with a polyurethane sealant such as Sikaflex 2C NS EZ Mix (NSF/ANSI 61 approved) by Sika Canada, or approved equal.

.6 Sealant shall be allowed to cure in accordance to the manufacturers written procedures.

3.11 Site Tolerances

3.11.1 Concrete tolerance in accordance with CSA A23.1/A23.2.

3.11.2 The Contractor shall survey the site and shall provide a drawing layout of the concrete work to be included in the “as built” drawings.

END OF SECTION

1 GENERAL

1.1 Scope of Work

1.1.1 Design, supply, delivery and installation of:

.1 Pre-stressed hollow core slab units and pre-stressed double tee slab units, prestressed beams, precast stairs and normally reinforced columns.

.2 This section includes product design, manufacture, anchorage, bearing pads, inserts and similar accessories required for work under this contract.

.3 Take delivery and cast into precast work boxes/inserts/openings required and supplied by other trades prior to casting.

1.1.2 Supply information required for the installation of bracing, supports, inserts and similar accessories required for the work under this Contract supplied and to be installed by others.

1.2 Related Sections

1.2.1 Section 01330 – Submittals

1.2.2 Section 03300 – Cast-in-Place Concrete

1.2.3 Section 03400 – Precast Concrete Wall Panels

1.2.4 Section 05120 – Structural Steel

1.2.5 Section 05500 – Metal Fabrications

1.2.6 Section 06610 – Fiberglass Reinforced Plastics

1.2.7 Section 07562 – Liquid Applied Waterproofing Membrane

1.2.8 Section 07550 – Modified Bitumen Membrane

1.3 Reference Standards

1.3.1 Canadian Standards Association (CSA):

.1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete

.2 CAN/CSA A23.3-19 - Design of Concrete Structures

.3 CSA A23.4-16 (R2021) - Precast Concrete-Materials and Construction

.4 CSA A283-19 - Qualification Code for Concrete Testing Laboratories

.5 CAN/CSA G30.18-09 (R2019) - Carbon Steel Bars for Concrete Reinforcement

.6 CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

.7 CSA W186-M1990 (R2016) - Welding of Reinforcing Bars in Reinforced Concrete Construction

.8 CSA W47.1-09 (R2019) - Certification of Companies for Fusion Epoxy-Coated Reinforcing Steel Bars

.9 CSA W59-18 – Welded Steel Construction (metal arc welding)

1.3.2 American Society for Testing and Materials (ASTM):

.1 ASTM A775/A775M-07b(2014) - Specification for Epoxy Coated Reinforcing Steel Bars

.2 ASTM D412-06a(2013) - Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension

.3 ASTM D2240-05(2010) - Test Method for Rubber Property – Durometer Hardness

.4 ASTM A123/A123M-13 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.5 ASTM A185/A185M-07 – Specification for Carbon-Steel Welded Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

.6 ASTM A276/A276M-16a - Standard Specification for Stainless Steel Bars and Shapes

.7 ASTM A416/A416M-18 - Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete

.8 ASTM A421/A421M-15 – Stress-Relieved Steel Wire for Prestressed Concrete.

.9 ASTM C494/C494M-13 - Specification for Chemical Admixtures for Concrete

.10 ASTM C1017/C1017M-13e1 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

1.3.3 Master Painters Institute (MPI):

.1 MPI #18 – Primer, Zinc Rich, Organic

.2 MPI #79 – Primer, Alkyd, Anti-Corrosive for Metal

1.3.4 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S701-11 – Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering

1.3.5 Precast/Prestressed Concrete Institute (PCI):

.1 PCI Journal V. 28, No. 1 (1983) – Fabrication and Shipment Cracks in Prestressed Hollow-Core Slabs and Double Tees

.2 PCI Manual for Design of Hollowcore Slabs

.3 PCI MNL 116 Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products

.4 PCI MNL-124 – Design for Fire Resistance of Precast/Prestressed Concrete, 3rd Edition.

.5 PCI MNL-120, PCI Design Handbook

1.3.6 Canadian Precast/Prestressed Concrete Institute (CPCI):

.1 CPCI Design Manual 5th Edition

1.3.7 Ontario Building Code

1.4 Qualifications of Manufacturer

1.4.1 Fabricator:

.1 Precast concrete manufacturers to be certified to Canadian Precast Concrete Quality Assurance (CPCQA) Certification Program in Commercial Precast and Prestressed Concrete Products (Structural) Category C2 prior to the time of bid.

.2 Precast fabrication to meet the requirements of CSA-A23.4-16, including Annexes A and B, together with PCI MNL-116 and 117 and CPCQA certification requirements.

.3 Only precast elements fabricated under the CPCQA plant certification program to be acceptable, and plant certification is to be maintained for the duration of fabrication, [erection,] and until warranty expires.

1.4.2 Fabricate precast/prestressed concrete elements certified by the Canadian Standards Association in the appropriate categories according to CSA A23.4. The precast concrete manufacturer shall be certified in accordance with the CSA Certification program for Structural Precast/Prestressed Concrete prior to submitting a tender and must specifically verify as part of the tender that the company is currently certified in the appropriate categories:

.1 Precast Concrete Products – Structural: (I) Non-Prestressed or (II) Prestressed.

.2 Precast Concrete Products – Specialty: (I) Non-Prestressed or (II) Prestressed.

.3 Only precast concrete elements fabricated by certified manufacturers are acceptable to the Owner. Certification must be maintained for the duration of the fabrication and erection for the project. Fabricate precast concrete elements in accordance with Ontario Building Code requirements.

1.4.3 The structural precast/pre-stressed concrete manufacturer shall have a proven record and satisfactory 10-year experience in the design, manufacture and erection of structural units specified. The company shall have adequate financing, equipment, plant and skilled

personnel to detail, fabricate and erect the work of this section as required by the specification and drawings. The size of the plant shall be adequate to maintain the required delivery schedule.

1.5 Bylaws and Codes

1.5.1 Conform to applicable requirements of the Ontario Building Code, National Building Code and local authorities having jurisdiction.

1.5.2 Design and provide reinforcement, anchors and support as required by codes and to Consultant's approval. Submit relevant design data prepared by a Professional Engineer registered in the Province of Ontario for approval, if so requested by the Consultant.

1.6 Allowable Tolerances

1.6.1 Conform to the requirements of CSA A23.4 - Clause 12.

1.6.2 Refer to related sections of this specification and fabricate work to accommodate specified tolerances.

1.7 Source Quality Control

1.7.1 Make available copies of quality control tests related to this project as specified in CSA A23.4.

1.7.2 Inspect pre-stressed concrete tendons in accordance with CSA A23.4.

1.7.3 Make available records from in-house quality control program based upon plant certification requirements for inspection and review.

1.7.4 Make available certified copy of mill test reports of steel reinforcement supplied, showing physical and chemical analysis.

1.7.5 In addition to quality control, an independent inspection and testing company may be appointed by the Owner to verify compliance with this specification.

1.7.6 Cooperate with inspector to facilitate the work.

1.7.7 Cost of an independent inspection is to be paid by the Owner.

1.8 Shop Drawings

1.8.1 Submit in accordance with Section 01330.

1.8.2 Prepare and submit certified shop drawings, stamped by a professional Engineer licensed in the Province of Ontario, of precast/prestressed concrete elements in accordance with general conditions of the contract, CSA A23.4 and CSA A23.3, and as specified below.

1.8.3 Submit fully detailed and dimensional drawings showing and including, but not limited to the following:

.1 Design calculations for items designed by manufacturer

.2 Typical details of prestressed members, reinforcement and connections, including all welds.

.3 Estimated camber.

.4 Finishing schedules.

.5 Methods of handling and erection.

.6 Openings, sleeves, inserts and related reinforcement.

.7 Hanger saddles and angles to accommodate openings.

1.8.4 Show the exact location of inserts and anchors required to be cast into precast/pre-stressed units for interface elements.

1.8.5 Show the system of identifying units for erection purposes on shop drawings and apply a similar mark on all units at the time of manufacture.

1.8.6 Provide the shop drawings to obtain approvals from the authorities having jurisdiction prior to fabrication of structural precast/prestressed units.

1.8.7 Provide drawings of all precast members.

1.8.8 Include all loading supported by the precast element based on approved shop drawings. Contractor to coordinate location of equipment and supply all loads to precast engineer for final design.

1.9 Warranty

1.9.1 Provide standard CPCI warranty with a duration of one (1) year in accordance with the General Conditions. Warranty shall be in writing and shall warrant work under this section to be free from defects for the period stipulated.

1.10 Delivery, Storage and Protection

1.10.1 Accept full responsibility for delivery, handling and storage of units.

1.10.2 Deliver, handle and store precast/prestressed structural units using methods approved by the manufacturer. Do not permit units to contact earth or staining influences or to rest on corners.

1.11 Design

1.11.1 Requirements: Design and fabricate precast/pre-stressed structural concrete elements, brackets and anchorage devices so that when installed they will:

.1 Compensate for allowable construction tolerances in the structure to which they are secured.

.2 Tolerate a structural deflection of span/360 due to roof live load.

.3 Adequately sustain themselves, and superimposed total loads, specified by the Engineer, without exceeding deflection of L/240.

.4 Design loads shall be as specified on the contract drawings, and in accordance with the Ontario Building Code. The structure is considered to be a “post disaster” building.

.5 Design all units to provide at least 50 mm of concrete cover to prestressed strands or main reinforcing, and 40 mm cover to all ties and stirrups.

.6 Design all elements to limit stresses exposed to a corrosive environment .

2 PRODUCTS

2.1 Materials

2.1.1 Reinforcing steel: to CSA G30.18 Grade 400 MPa, deformed bars.

2.1.2 Prestressing tendons: to ASTM A416 Grade 1720 MPa, prestressing strands.

2.1.3 Forms: to CSA A23.4, one-piece, full-length, and without seams.

2.1.4 Hardware and miscellaneous materials: to CSA A23.1/A23.2.

2.1.5 Welding materials: to CSA W47.1.

2.1.6 Air entrainment admixture: to ASTM C1017/C1017M.

2.1.7 Bearing pads: neoprene, 70 durometer hardness to ASTM D2240 and 17 MPa minimum tensile strength to ASTM D412, moulded to size or cut from moulded sheet. (Random oriented fibre-reinforced neoprene.)

2.1.8 Shims: plastic

2.1.9 Hanger saddles and angles: to CSA G40.20/G40.21, Grade 300W

2.1.10 Cement Grout: minimum 25MPa at 28 days.

2.2 Concrete Mixes

2.2.1 Unless otherwise noted or specified, use concrete mix designed to produce a minimum of 35 MPa compressive cylinder strength at 28 days, with a maximum water/cement ratio to CSA A23.4.

2.2.2 Use cement and supplementary cementing materials that conform to CSA A23.1/A23.2.

2.2.3 Air Entrainment of Concrete Mix: refer to CSA A23.1/A23.2.

2.2.4 Use of calcium chloride is not permitted.

2.2.5 Exposure Class: C-1 in accordance to CSA A23.1/A23.2.

2.3 Reinforcement and Anchors

2.3.1 Anchors: All connection hardware shall be fabricated from 316L stainless steel.

2.3.2 Reinforcing Steel: to CSA G30.18 epoxy coated for all non-pre-stressed steel with less than 45mm cover.

2.4 Fabrication

2.4.1 Fabricate precast/pre-stressed concrete units to CSA A23.4.

2.4.2 Mark each precast/pre-stressed unit to correspond to identification mark on shop drawings for location.

2.4.3 Mark each precast unit with the date cast.

2.4.4 Cast members in accurate rigid moulds designed to withstand high frequency vibration. Set reinforcing anchors and auxiliary items to detail. Cast in anchors, blocking and inserts supplied by other sections as required to accommodate their work. Vibrate concrete during casting until full thickness is reached. Provide necessary holes and sinkages for flashings, anchors, cramps, etc. as indicated. Separately and accurately batch cement and aggregates uniformly by weight to ensure maintenance of even and uniform appearance.

2.4.5 Anchors, lifting hooks, shear bars, spacers and other inserts or fittings required shall be as recommended and/or designed by manufacturer for a complete and rigid installation. Each shall conform to requirements of local building bylaws. Lift hooks shall be adequately sized to safely handle panels according to member dimension and weight. Anchors/inserts shall be concealed where practical.

2.4.6 Openings: Opening locations shall be coordinated and verified by the Contractor and provide information to the manufacturer. Manufacturer shall provide openings 300 mm square or larger and shown on the architectural and structural drawings. Small openings (less than 300 mm square) shall be drilled or cut by the respective trades after plank is grouted. Prior to field cutting, openings must be approved by the manufacturer.

2.4.7 Burn off lift cables paint and fill in recesses.

2.5 Finish

2.5.1 Finish units to Finish Grade B to CSA A23.4, Clause 26.

2.6 General Requirements

2.6.1 Furnish units free of voids or honeycombs.

2.6.2 Provide rough bonding surface on slabs for topping where specified.

2.6.3 Reinforce units to resist transportation and erection stresses.

2.6.4 Include stainless steel cast-in weld plates.

2.6.5 Coordinate with other trades for installation of cast-in items. Coordinate specifically with roofing supplier and general contractor to ensure that hardware used for connections does not interfere with roofing or connections and are adequately protected.

2.6.6 Ensure that the underside of all units is free of staining, discoloration, or dirt. Clean all units to a consistent appearance. If staining is permanent, replace double tee unit at no cost to the Contract.

2.6.7 If a precast unit has a defect or damage deemed to be potentially structural in nature, as determined by Section 33.3.2 of CSA A23.4, repair the unit in accordance with Section 33.3.3 of CSA A23 at no cost to the contract. All repair methods and materials shall be submitted to the engineer for review, including any requirements for load testing. Load test the units if requested by the engineer.

2.6.8 Patch cosmetically damaged or chipped components as determined by the Engineer using a methodology approved by the Engineer.

2.7 Hollowcore Units

2.7.1 Precast/pre-stressed floor units shall be 203 mm and 254 mm thick components with prestressed reinforcement as required by design.

2.7.2 The finish of the underside of the slabs shall be a standard steel form finish.

2.7.3 Finish on the top side shall be raked to promote adhesion to concrete topping.

2.8 Double Tee Units

2.8.1 Type: Precast Double Tee roof units of depth shown on the drawings.

2.8.2 Finish on the top side shall be raked to promote adhesion to concrete topping.

2.8.3 Coordinate opening sizes of access hatches with Section 08310 – Access Hatches.

2.9 Beam Units

2.9.1 Type precast/pre-stressed beams of the depth and cross section shown on the drawings.

2.10 Column Units

2.10.1 Type precast columns of cross section shown on the drawings.

2.11 Stair Units

2.11.1 Type precast/pre-stressed stairs for the width and cross section shown on the drawings.

2.11.2 Rise and run dimensions to satisfy requirements of Ontario Building Code.

2.11.3 Provide anti-slip troweled grooves on treads with bullnose nosing.

2.11.4 Coordinate guardrail assembly and connection requirements with metal/FRP fabricator in Section 05500 – Metal Fabrications and Section 06610 – Fiberglass Reinforced Plastics.

3 EXECUTION

3.1 General

3.1.1 Erect precast/pre-stressed work in accordance with CSA A23.4.

3.1.2 Supply stainless steel anchors or plates for precast units required to be cast into cast-in place concrete frame to Contractor for installation.

3.1.3 Provide such items in ample time to meet construction program. Supply layout drawings locating accurately the position of all cast-in items to be installed by other sections.

3.1.4 Provide minimum 50 thick insulation plugs at the ends of each hollow core location.

3.1.5 Supply and install welded wire fabric in topping as indicated on the contract drawings.

3.2 Installation

3.2.1 Set precast/pre-stressed concrete units, straight, level and square.

3.2.2 Do welding in accordance with CSA W59, for welding to steel structures and CSA W186, for welding of reinforcement. Design welds where shown on structural drawings.

3.2.3 Non-cumulative erection tolerances to be in accordance with CSA A23.4, Clause 12.

3.2.4 Set elevations and alignment between units to within allowable tolerances before connecting units.

3.2.5 Grout joints of precast units with 25 MPa concrete grout and “feather”. Ensure there are no rough areas, projections or abrupt changes in roof elevation.

3.2.6 Secure with bolts using tack-weld nut to bolt.

3.2.7 Do not weld or secure bearing plates at sliding joints.

3.2.8 Use grout to align elevations at surface of joints in situations where allowable tolerances have been exceeded or as noted on Engineer’s drawings in critical splatter.

3.2.9 Caulk joints between hollowcore panels/double tees at ceiling, complete with backer rod. Use Sika 2CNS or approved equal.

3.3 Handling and Erection

3.3.1 Precast/prestressed components shall be handled and erected in accordance with CSA Standard A23.4 and as per the manufacturer’s instructions.

3.3.2 Precast/prestressed components shall be delivered and handled in such a manner as to avoid warpage.

3.3.3 Holes and reglets shall be protected from forming of ice during freezing weather.

3.3.4 Lifting devices shall be protected from rusting at all times.

3.3.5 All precast/prestressed components shall be erected by experienced workmen under the supervision of a qualified superintendent with a minimum of five (5) years of experience.

3.3.6 Welding of precast units shall be performed by certified welders in accordance with CSA Standard A23.4, Clause 32.7.

3.3.7 Units shall be set plumb and true with joints parallel and uniform.

3.3.8 All necessary precautions shall be taken to prevent weld burn or splatter onto exposed surfaces. Clean areas effected by burns or splatter to the satisfaction of the Engineer.

3.4 Repairs

3.4.1 Patch cosmetically damaged or chipped components as determined by the Engineer using a methodology approved by the Engineer.

3.4.2 Repair all cracks in accordance with PCI Journal – Fabrication and Shipment Cracks in Prestressed Hollowcore Slabs and Double Tees.

3.4.3 If defect or damage is deemed to be potentially structural in nature, as determined by Section 33.3.2 of CSA A23.4, repair the unit in accordance with Section 33.3.3 of CSA A23.4 at no cost to the contract. All repair methods and materials shall be submitted to the engineer for review, including any requirements for load testing. Load test the units if requested by the engineer.

3.4.4 Provide a top surface suitable for the installation of the membrane roofing specified under Section 07550 – Modified Bitumen Membrane.

3.5 Cleaning

3.5.1 If required, clean exposed face of work by washing and brushing only, as precast is erected. Use approved masonry cleaner if washing and brushing fails to achieve required finish. Remove immediately materials that may set up or harden. This section is not responsible for soiling or damage by others.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers procurement and installation of grout beneath column base plates, grouting of pump, motor and equipment base plates or bedplates, and other structural uses of grout as indicated on the drawings. Unless otherwise specified, only non-shrinking grout shall be furnished.

1.1.2 Epoxy grouting of anchor bolts, threaded rod anchors and reinforcing bars are covered in the Anchorage in Concrete and Masonry section. Grouting of masonry is covered in the Building Masonry section.

1.2 Related Specification Sections

1.2.1 Section 01330 – Submittal Procedures

1.2.2 Section 04051 – Masonry Mortar and Grout

1.2.3 Section 05120 – Structural Steel

1.2.4 Section 05550 – Anchorage in Concrete and Masonry

1.3 Submittals

1.3.1 Submit shop drawings in accordance with the Section 01330 – Submittals.

1.3.2 Include technical data sheet for each product and clearly indicate location and the intended use of each type.

1.3.3 A letter of certification from manufacturer indicating the types of grout to be supplied is appropriate for the intended use. Forming method for fluid grout placements.

1.3.4 Curing method for grout.

1.4 Delivery, Storage and Handling

1.4.1 Materials shall be handled, transported and delivered in a manner that will prevent damage of any kind. Materials shall be protected from moisture.

2 PRODUCTS

2.1 Materials

2.1.1 Non-shrinking Grout: cementitious grout with demonstrated non-shrinking properties; BASF Master Builders Solutions “Masterflow 928”, Sauereisen “F-100 Level Fill Grout”, or Five Star Products “Five Star Grout”.

2.1.2 Epoxy Grout: Sikadur 42 MultiFlo by Sika, MasterFlow 648 by BASF.

2.1.3 Water: Clean and free from deleterious substances.

2.1.4 Min 28 Day Compressive Strength: 50MPa

2.1.5 Aggregate: where required due to the thickness of the grout extends with aggregate in accordance with the manufacturers written recommendations.

2.2 Non-shrinking Grout

2.2.1 Non-shrinking grout shall be furnished factory pre-mixed so that only water is added at the job site.

3 EXECUTION

3.1 Preparation

3.1.1 Mechanically roughen the surface as per manufacturers written instructions

3.1.2 The concrete foundation to receive non-shrinking grout shall be saturated with water for at least 12 hours preceding grouting unless additional time is required by the grout manufacturer.

3.1.3 Remove all standing water prior to application of grout.

3.2 Installation

3.2.1 Mixing

.1 Mix materials in accordance with manufacturer's instructions.

.2 Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.

.3 Do not mix more grout than can be placed in approximately 30 minutes.

.4 Do not retemper grout by adding water and remixing after it stiffens.

3.2.2 Placement

.1 Unless otherwise specified or indicated on the drawings, grout under base plates shall be 38 mm thick. Grout shall be placed in strict accordance with the directions of the manufacturer so that all spaces and cavities below the base plates are completely filled without voids. Forms shall be provided where structural components of base plates will not confine the grout.

3.2.3 Edge Finishing

.1 In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. The edges of grout shall be cut off flush at the base plate except where shown to be finished on a slope.

3.2.4 Curing

.1 Cure grout in accordance with manufacturer's instructions.

.2 Non-shrinking grout shall be protected against rapid loss of moisture by covering with wet cloths or polyethylene sheets. After edge finishing is completed, the grout shall be wet cured for at least three (3) days and then an acceptable membrane curing compound shall be applied.

3.2.5 Protection

.1 Protect grout from temperatures at and below 32 degrees F (0 degrees C) until grout has attained compressive strength of 3,000 psi (21 MPa).

.2 Protect completed grout from damage during construction.

3.3 Field Quality Control

3.3.1 Evaluation and Acceptance of Nonshrink Hydraulic Cement Grout:

.1 Provide a flow cone and cube molds with restraining plates onsite. Continue tests during Project as demonstrated by grout manufacturer's representative.

.2 Perform flow cone and bleed tests, and make three 50 mm by 50 mm cubes for each cubic metre of each type of nonshrink grout used. Use restraining caps for cube.

.3 For large grout applications make three additional cubes and one more flow cone test. Include bleed test for each additional cubic metre of nonshrink grout placed.

.4 Consistency: As specified in Article Nonshrink Grout. Grout with consistencies outside range requirements will be rejected.

.5 Segregation: As specified in Article Nonshrink Grout. Grout when aggregate separates will be rejected.

.6 Tests must show that strength attained by nonshrink grout cubes is equal to or greater than minimum strength specified.

.7 Strength Test Failures: Remove and replace nonshrink grout work failing strength tests.

.8 Perform bleeding test to demonstrate grout will not bleed.

.9 Store cubes at 21°C.

.10 Independent testing laboratory to prepare, store, cure and test cubes.

3.4 Manufacturer's Services

3.4.1 General

.1 Coordinate demonstrations, training sessions, and applicable site visits with grout manufacturer's representative.

.2 Provide and conduct onsite, demonstration and training sessions for all measurements, testing, application, and curing for each category and type of nonshrink grout.

.3 Ensure necessary equipment and materials are available for demonstration.

.4 Training is required for all Type III and epoxy grout installations.

.5 Grout manufacturer's representative to train Contractor to perform grout work.

.6 Establish location at site and schedule time for grout manufacturer's demonstration and training session of proposed nonshrink grouts. Mix nonshrink grouts to required consistency, test, place, and cure on actual Project, e.g., baseplates and tie holes to provide actual on-the-job training.

.7 Training to include methods for curing grout.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers furnishing and installation of epoxy grouting of anchor bolts and threaded rod anchors to be installed in hardened concrete.

1.2 References

1.2.1 American Society for Testing and Materials (ASTM):

.1 ASTM C881/C881M-13 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

2 PRODUCTS

2.1 Materials

2.1.1 Epoxy Adhesive Grout:

.1 Adhesive: Moisture-insensitive.

.1 HIT-HY 200 adhesive, by HILTI
.2 SET epoxy adhesive by, Simpson Strong-Tie
.3 AnchorFix anchoring adhesive, by SIKA
.4 Or approved equivalent.

2.1.2 When the anchoring details are provided by the equipment manufacturer, following all recommendation and requirement of the manufacturer, including the requirement on grout.

3 EXECUTION

3.1 Epoxy Grout

3.1.1 Epoxy grout shall consist of a two component liquid epoxy adhesive of viscosity appropriate to the location and application, and an inert aggregate filler component, if recommended by the adhesive manufacturer. Components shall be packaged separately at the factory and shall be mixed immediately before use. Proportioning and mixing of the components shall be done in accordance with the manufacturer's recommendations.

3.1.2 Preparation: Where indicated on the drawings, anchor bolts and threaded rod anchors shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be as follows:

Item	Diameter of Hole
Threaded Rod Anchors	3 mm larger than the outside diameter of the bar or the rod
Headed Anchor Bolts	Bolt diameter plus 50 mm

.1 The embedment depth for epoxy grouted anchor bolts and threaded rod anchors shall be at least 15 bolt or rod diameters, unless otherwise indicated on the drawings.

.2 Holes shall be prepared for grouting as recommended by the grout manufacturer.

3.1.3 Installation: Anchor bolts and threaded rod anchors shall be clean, dry and free of grease and other foreign matter when installed. The bolts, rods and bars shall be set and positioned and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with epoxy grout, without voids. During assembly of all threaded stainless steel components, anti-seize thread lubricant shall be liberally applied to the threaded portion not embedded in concrete.

END OF SECTION

DIVISION 4 – MASONRY

Section No.	Title
04050	Masonry Procedures
04051	Masonry Mortar and Grout
04052	Masonry Anchorage and Reinforcing
04053	Masonry Accessories
04211	Brick Unit Masonry
04220	Concrete Masonry Units

1 GENERAL

1.1 General

1.1.1 Conform to Sections of Division 1 as applicable.

1.2 Related Sections

1.2.1 Section 03300 - Cast-in-Place Concrete

1.2.2 Section 04051 - Masonry Mortar and Grout

1.2.3 Section 04052 - Masonry Anchorage and Reinforcing

1.2.4 Section 04053 - Masonry Accessories

1.2.5 Section 04211 - Brick Unit Masonry

1.2.6 Section 04220 - Concrete Masonry Unit

1.2.7 Section 05500 - Metal Fabrications

1.2.8 Section 05550 - Anchorage in Concrete and Masonry

1.2.9 Section 07212 - Board Insulation

1.2.10 Section 07213 – Batt and Blanket Insulation

1.2.11 Section 07270 - Self-Adhered Air Vapour Barrier Membrane

1.2.12 Section 07840 - Fire Stopping

1.2.13 Section 07900 – Joint Sealants

1.2.14 Division 15 &16 - Mechanical & Electrical items to be built into Masonry.

1.3 References

1.3.1 All products shall conform to the following standards and regulations:

.1 ASTM International (ASTM).

.1 ASTM A153/A153M-16a - Zinc Coating (Hot-Dip) on Iron and Steel Hardware

.2 ASTM A580/A580M-18 - Standard Specification for Stainless Steel Wire

.3 ASTM A666-15 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

.4 ASTM C67/C67M-20 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile

.5 ASTM C207-18 - Standard Specification for Hydrated Lime for Masonry Purposes

.6 ASTM C1329/C1329M-16a - Standard Specification for Mortar Cement

.7 ASTM D41/D41M-11 (2016) – Specification for Asphalt Primer Used in Roofing, Dampproofing and Waterproofing

.8 ASTM D6769/D6769M-02(2018) – Standard Guide for Application of Fully Adhered, Cold Applied, Prefabricated Reinforced Modified Bituminous Membrane Waterproofing Systems

.2 Canadian Standards Association (CSA):

.1 CAN/CSA A3000-18 - Cementitious Materials Compendium

.2 CAN/CSA A82-14 - Fired Masonry Brick Made From Clay or Shale.

.3 CAN/CSA A165 Series-14 – CSA Standards on Concrete Masonry Units

.4 CAN/CSA A179-14 - Mortar and Grout for Unit Masonry

.5 CSA S304-14 - Design of Masonry Structures

.6 CSA A370-14 (R2018) - Connectors For Masonry

.7 CAN/CSA A371-14 - Masonry Construction for Buildings

.3 Building: The Brick Industry Association (BIA) Technical Notes on Brick Construction

.4 International Masonry Industry All-Weather Council (IMIAC)

.1 Recommended Practices and Guide Specification for Hot and Cold Weather Masonry Construction

1.4 Products Installed but not Supplied under This Section

1.4.1 Build, bed and secure into the masonry work the following materials which are supplied by other trades:

.1 Masonry inserts, hangers, anchors, sleeves, bolts, etc.

.2 Steel lintels bearing on the masonry work.

1.5 Administrative Requirements

1.5.1 Pre-installation meetings: comply with Section 01300- Administrative Requirements. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Verify project requirements, including mock-up requirements.

.2 Verify substrate conditions.

.3 Co-ordinate products, installation methods and techniques.

.4 Sequence work of related sections.

.5 Co-ordinate with other building sub-trades leaving all chases, slots and reglets and building-in all frames, sleeves, anchors, bolts, etc. as supplied by others and to ensure proper installation and site preparation.

.6 Review manufacturer's installation instructions.

.7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.

.8 Review warranty requirements.

1.5.2 Sequencing: sequence with other work in accordance with Section 01120 Work Sequences and Tie-Ins.

1.6 Submittals

1.6.1 Make submittals in accordance with Section 01330 Submittals.

1.6.2 Test Reports:

.1 Submit test reports showing compliance with specified performance characteristics and physical properties including permeability.

1.6.3 Field Reports:

.1 Manufacturer’s field reports within 3 days of manufacturer representative’s site visit and inspection.

1.6.4 Shop Drawings

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Provide shop drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.

.3 Submit showing

.1 locations of control/expansion joints

.2 setting sequence;

.3 stone size and shapes;

.4 bonding details, anchor and insert types;

.5 connections to supporting walls and structure; and

.6 installation methods and anchoring methods.

1.6.5 Product Data: Submit product data including manufacturer's literature for masonry, and accessories, indicating compliance with specified requirements and material characteristics.

.1 Include product names, types and series numbers.

.2 Include contact information for manufacturer and their representative for this Project.

.3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01330 Submittal procedures

.1 Indicate VOC's mortar, grout, parging, colour additives and admixtures.

.2 Indicate VOC's for epoxy coatings and galvanized protective coatings and touch-up products.

1.6.6 Samples: prior to commencement of the Work submit samples

.1 Four samples of each type of concrete, masonry and stone unit specified to illustrate size, colour and texture.

.2 One cured and coloured sample of mortar and grout, illustrating mortar colour and colour range, supplemented with specific requirements in Section 04051 - Masonry Mortar and Grout.

.3 Two samples of each types masonry accessories and flashing specified, supplemented by specific requirements in Section 04053 - Masonry Accessories

.4 Two types of each tie, connector or reinforcement proposed for use, supplemented by specific requirements in Section 04052 - Masonry Anchorage and Reinforcing.

.5 Samples of panel reinforcing, anchors, expansion strips and sealant for glass block.

.6 Indicate bar bending schedule, placing diagrams, sizes, location, and quantities of reinforcement and connectors.

.7 Samples: used for testing and when accepted become standard for material used.

1.6.7 Quality Control Procedures:

.1 As required, submit proposed quality control procedures for cold/hot weather protection and curing for Engineer's approval.

1.6.8 Statement of Compatibility:

.1 Submit a Statement of Compatibility from manufacturers of insulation, air barrier, air barrier flashing and insulation fastener adhesive. Statement of Compatibility is to indicate that the manufacturer warrants the performance of their product when it is used in contact with other manufacturer's products listed above.

1.6.9 Qualifications:

.1 Manufacturer: capable of providing field service representation during construction and approving application method.

.2 Installer: Membership in good standing of the Ontario Masonry Contractor's Association, Industrial, Commercial Institutional Category. Minimum five years proven satisfactory experience installing masonry on projects of comparable scope and using qualified tradesman.

.3 Masons: Minimum five years proven acceptable experience installing masonry on projects of comparable size and scope and using tradesman trained in the application of air barriers. Prior to commencement of masonry construction submit list of project names, owners, contacts, dates completed and construction costs.

.4 Masons employed on this project must demonstrate ability to reproduce mock-up standards.

1.6.10 Warranty

.1 Submit copy of manufacturer’s standard warranty on component fabrication, workmanship and finishes.

.2 For Work in this Section 04050 – Masonry Procedures, 12 months.

1.6.11 Restoration Process: Where indicated, submit Drawings and Specifications including materials, construction methods, equipment, cleaning process and sequence of work.

1.7 Quality Assurance

1.7.1 Conform to requirements of CSA S304 for design requirements and for construction requirements to CSA A370, CAN/CSA A371 except where more stringent requirements are noted and/or indicated on Drawings and specified herein.

1.7.2 Certificates

.1 Submit manufacturer's signed certificate verifying that masonry reinforcement supplied to project conforms to ASTM A153 / A153M-05, Class B-2 hot dipped galvanized requirements.

1.7.3 Provide for compartments in long cavity wall and at corners to achieve appropriate pressure equalization and drainage in cavity wall design. Where not provided in other specifications, the following minimal dimensions shall be followed.

.1 Compartments located within 1.2 m along the edges of the façade, including top of parapets, outside and inside corners, shall have a horizontal dimension no larger than 1.2 m

.2 Compartments located within the central portion of the façade, shall have a horizontal dimension no greater than 6.0 m.

.3 All Compartments shall have a vertical dimension no greater 6.0 m

1.7.4 Conform to CAN/CSA A179, for type and grade specified and ensure bricks pass ASTM C67, No Dry Freeze Thaw Test.

1.7.5 Conform to the Occupational Health and Safety Act. Lay masonry from scaffolds erected on same side as face work. Do not support scaffolding from finished building surfaces.

.1 Erect, maintain and remove on completion, scaffolding adequate for proper execution of work

1.7.6 Conform to CSA A371 for temporary wind bracing for masonry during construction.

.1 Provide temporary bracing for masonry work during erection to prevent damage due to winds or other lateral loads until permanent structure provides adequate bracing.

1.7.7 MockUp

.1 Construct mock-ups in accordance with Section 01450 Quality Control

.2 Purpose: To judge quality of work and material installation.

.3 Mock-up: Construct full size 3 x 3 m mock-up of masonry wall using proposed procedures, materials and quality of work where directed by Engineer.

.4 Include: Window or door frame, trim, sill, flashing, vapour barrier plus related transitions, sealants, masonry accessories, masonry connectors and ties, lintel, siding and any other products outlined in pre-installation meetings.

.6 Allow Consultant 48 hours minimum prior to inspection of mock-up.Construct additional panels, if required, to obtain approval. Do not proceed with work prior to receipt of written acceptance of mock-up by Engineer.

.8 Approved panels shall become standard of comparison for masonry work on Site and shall not be destroyed or moved until authorized by Consultant.

.9 Perform test clearing on mock-up panel to ensure desired result.

.10 Start work only upon receipt of written approval of mock-up by Engineer.

.11 Mock-ups may remain as part of Work, unless indicated otherwise in a technical specification Section.

1.8 Delivery, Storage and Handling

1.8.1 Deliver and store masonry units on Site on pallets and locate well away from roads. If not used immediately after delivery, cover with waterproof cover adequately secured. Keep units protected from roofing bitumen, concrete, mortar, and other materials which could stain them. Do not double stack cubes of masonry.

1.8.2 Protect masonry in accordance with requirements of CAN/CSA A371. Keep masonry materials completely free from ice and frost.

1.8.3 Store bagged products, such as lime, cement, and metal accessories in dry, waterproof sheds.

1.9 EnvironmenTal Requirements

1.9.1 CSA A371, Masonry Construction for Buildings

.1 Clause 5.16.2 Cold Weather Requirements

.2 Clause 5.16.4 Hot Weather Requirements

1.10 Cold Weather Requirements

1.10.1 When laying masonry in ambient temperature below 5^0C, use heat and maintain temperature of masonry materials. Protect completed work from freezing to satisfaction of Consultant. Heat and maintain temperature of masonry materials to at least 5^0C, but not more than 50^0C, and maintain air temperature above 5^0C on both sides of masonry for period of at least 7 days.

1.10.2 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.

1.10.3 Use warm water and use less mix water in winter; cover sand to keep dry; heat sand and ensure no frozen lumps; use small batches; provide temporary heat and weather protection enclosure at area of masonry work; cover top of all unfinished work to prevent water or ice getting into masonry work.

1.11 Hot Weather Requirements

1.11.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

1.11.2 Avoid using dry masonry in hot weather conditions. Use predampened brick nominally saturated, but surface dry at time of laying. Do not dip brick in bucket of water.

1.11.3 Spread only enough mortar to permit soft setting of masonry units; do not over mix mortar materials; do not retemper mortar after two hours of use; do not retemper pigment coloured mortar; do not spread more than 900 mm of mortar for placement of brick.

1.11.4 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.

1.11.5 Spray mortar surface at intervals and keep moist for maximum of three days after installation.

2 PRODUCTS

2.1 Materials

2.1.1 Refer to related Sections for materials.

3 EXECUTION

3.1 Installers

3.1.1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

3.2 Manufacturer's Instructions

3.2.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 Examination

3.3.1 Verify that site conditions are ready to receive work.

3.3.2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.

.1 Inform Engineer of unacceptable conditions immediately upon discovery.

.2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Engineer.

3.3.3 Verification of Conditions:

.1 Verify that:

.1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of brick and concrete block .

.2 Field conditions are acceptable and are ready to receive work.

.3 Built-in items are in proper location, and ready for roughing into masonry work

3.3.4 Beginning of installation means acceptance of site conditions.

3.4 Preparation

3.4.1 Surface Preparation: prepare surface in accordance with manufacturer's instructions and written recommendations.

3.4.2 Establish and protect lines, levels, and coursing.

3.4.3 Protect adjacent materials from damage and disfiguration.

3.4.4 Supply metal anchors to Section 04052 - Masonry Anchorage and Reinforcing for placement. Direct correct placement of metal anchors.

3.4.5 Verify items provided by other sections of work are properly sized and located.

3.5 Cutting of Masonry Units

3.5.1 Wet saw masonry units

3.5.2 Pre-soak units using clean water prior to cutting.

3.5.3 Make cuts straight, clean, and free from uneven edges.

3.5.4 Clean cut units using a stiff fibre brush and clean water. Allow units to surface dry prior to placement.

3.5.5 Cut out neatly for electrical switches, outlet boxes, and other recessed or built-in objects.

3.5.6 Make cuts in existing concrete block for doors to be neat, straight and true. Grout solid all voids.

3.6 Wetting of Bricks

3.6.1 Except in cold weather, wet bricks having initial rate of absorption exceeding 1g/minute/1000 mm²: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.

3.6.2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.

3.7 Installation

3.7.1 Do masonry work in accordance with CSA S304.1 and CAN/CSA A371 except where specified otherwise.

3.7.2 Do masonry mortar and grout work in accordance with CAN/CSA A179 and CAN/CSA A371 except where specified otherwise.

3.7.3 Perform work by skilled workmen under the continuous supervision and direction of skilled and experienced foreman in each branch of the work. At least one thoroughly experienced and competent workman is to be in charge of all mortar mixing.

3.7.4 Do not use scorched sand. Do not use salts or anti-freezes. Use approved smokeless heaters.

3.8 Coursing

3.8.1 Execute work to prevent marking or staining of exposed faces. Clean exposed masonry faces as work proceeds.

3.8.2 Set out and build masonry work to the respective dimensions called for on the drawings. Build and lay masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA A371.

.1 Buttering corners of units, throwing mortar droppings into joints, deep or excessive furrowing of bed joints will not be permitted. Demonstrate practices and procedures for maintaining clean cavity to Engineer in mock-up panel.

.2 Do not shift or tap units after mortar has taken initial set. Where adjustment must be made after mortar has started to set, remove mortar and replace with fresh supply.

.3 Lay all joints approximately 10 mm thick unless otherwise specified or otherwise indicated on Drawings. Fill joints full of mortar except where specifically designated to be left open.

.4 Allow joints to set just enough to remove excess water, then tool as follows:

.1 When mortar is "thumb-print," hard tool joints slightly concave for exposed work; elsewhere, strike joints flush. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess material or burrs left after jointing. Use trowel or rub with burlap bag.

.2 At exterior walls, match joint profile of existing adjacent joints.

.3 Strike flush all joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.

.4 Use only non-corroding joint forming tools made of stainless steel or hard plastic.

.5 Use bullnose and double bullnose block at all external corners where block is left exposed.

.6 Provide exterior inspection ports in cavity walls by leaving out every 6th brick (or 3rd block) of first course over all dampproof courses and flashings until wall panel supported by that course of units is constructed and reviewed. Clean cavity and obtain Engineer's review before filling inspection ports to match adjacent masonry.

3.9 Construction

3.9.1 Exposed masonry:

.1 Percentage of chipped block faces installed shall be 0%.

.2 Remove chipped, cracked, and otherwise damaged units, in accordance with CSA A165, in exposed masonry and replace with undamaged units

3.10 Control Joints

3.10.1 Control joints shall be spaced in accordance with BIA technical notes 18 and 18A.

3.10.2 Do not continue horizontal joint reinforcing across movement control joints.

3.10.3 Form movement control joints by leaving head joints between stacked units void of mortar, ready for application of bond breaker and joint sealant.

3.10.4 Size joint in accordance with Section 07900 Joint Sealants for sealant performance.

3.10.5 Joints in masonry shall be located at least 300mm from any opening in the wall, unless specifically noted otherwise.

3.10.6 In no case shall the distance between control joints exceed 10m and 6m from corners.

3.11 Continuous Horizontal Reinforcement and Reinforcing Ties

3.11.1 Refer to section 04052 – Masonry Anchorage and Reinforcing

3.12 Setting and Building-In

3.12.1 Tie masonry veneer to backing in accordance with OBC requirements, CSA S304.1, CAN/CSA A371 and as indicated.

3.12.2 Build in items occurring in masonry provided by other Sections including; door frames; anchor bolts; sleeves; inserts; loose steel lintels; shelf angles; access panels; masonry flashings not in direct connection with roofing and other such items.

3.12.3 Build in items to present neat, rigid, true and plumb installation.

3.12.4 Leave wall openings required for ducts, grilles, pipes, and other items.

3.12.5 Accurately locate and neatly finish chases and openings to the required sizes.

3.12.6 Do not cover pipe, conduit chases or enclosures until advised that the work has been inspected and tested.

3.12.7 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

3.12.8 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with sealant in accordance with Section 07900 Joint Sealants.

3.12.9 Build in reglets, through-wall flashings, vapour barriers, and insulation as work progresses

3.12.10 Firestopping and Smoke Seal: Firestopping and smoke seals around penetrations, at control joints and deflection spaces in fire separations shall be part of work of Section 07840, Fire Stopping. Provide assistance as required to trade performing firestopping.

.1 Fill voids between masonry and metal frames with masonry mortar or insulation, as indicated.

3.13 Support of Loads

3.13.1 Use 20 MPa concrete to Section 03300 - Cast-in-Place Concrete, where concrete fill is used in lieu of solid units.

3.13.2 Use grout to CAN/CSA A179 where grout is used in lieu of solid units.

3.13.3 Install building paper below voids to be filled with concrete; keep paper 25 mm back from faces of units.

3.14 Provision for Movement

3.14.1 Leave 3 mm space below shelf angles.

3.14.2 Coordinate space between top of non-load bearing walls and partitions and structural elements with structural details. Do not use wedges.

3.14.3 Built masonry is to tie in with stabilizers, with provision for vertical movement.

3.14.4 Build-in continuous expansion joints as indicated.

3.15 Concrete Masonry Unit Lintels

3.15.1 Unless otherwise noted, provide reinforced concrete masonry unit lintels for full thickness of the wall. Provide reinforcement as indicated on the drawings.

.1 Lintels shall have minimum bearing of 200 mm on the masonry walls.

.2 Fill such lintels with grout and leave the shoring in place for a minimum of 7 days before removal.

.3 Lintels may be precast on the ground.

.4 Set concrete unit masonry over lintel units in full mortar bedding which shall have approved horizontal joint reinforcement laid therein

3.16 Loose Steel Lintels

3.16.1 Install loose steel lintels. Centre over opening width.

3.16.2 Clean all steel lintels by scraping, wire brushing or other effective means to remove loose scale, rust, grease, oil or other foreign matter.

3.16.3 Angle lintels shall have a bearing of not less than 200 mm at each end.

3.16.4 Touch-up damaged galvanized coating w/ zinc-rich coating.

3.17 Dampcourse and Flashing

.1 Install dampcourses and flashings where indicated on Drawings. If not fully indicated, install in locations as follows and as specified hereafter.

.1 Below second exterior block masonry course and fourth exterior brick course above new grade line.

.2 Over exterior lintels and shelf angles.

.3 Below first masonry course of inner wythe at floors on grade. Extend dampcourse through full thickness of inner wythe.

.4 Wherever roofs or other exterior, horizontal surfaces intersect masonry walls, immediately above roof flashing or horizontal surface flashing and seal to roof or other flashing or vapour barrier.

.2 In cavity walls install reinforced modified bitumen thru-wall flashings through full thickness of exterior wythe horizontally across cavity and through insulation to terminate with minimum 150 mm vertical leg against air/vapour barrier. Maintain integrity of air/vapour barrier without damaging flashing, membrane, and insulation thermal blanket.

.3 At shelf angles install flashing through exterior wythe up and over shelf angle, horizontally through insulation turning up wall, terminate at, and adhere to air/vapour barrier as specified herein before.

.4 Place flashing to present neat, even appearance. Remove excess material projecting more than 5 mm beyond edge of support.

.5 In non-cavity wall, install reinforced modified bitumen flashing through full thickness of wall to provide dampproofing course in accordance with manufacturer's recommendations.

.6 Where brick is laid against concrete without air/vapour membrane with less than 25 mm clear space separating them, apply two (2) coats dampproofing to concrete. Application: ASTM D41/D41M and ASTM D6769/D6769M.

.7 Install flashings and dampproofing courses to provide continuous waterproofing flashing in wall except where such courses occur over openings in walls, extend them past opening minimum of 200 mm and turn up minimum 150 mm at each end to create waterproof dam to prevent water draining into cavity.

3.18 Below Grade Parging

3.18.1 Not Used.

3.19 Air/Vapour Barrier Application

3.19.1 Ensure surface to receive membrane is smooth, flat, dry, clean, and free from dust, dirt and other materials detrimental to bonding membrane using torch. If membrane manufacturer so requires apply primer to exterior wall of the type and at rate recommended by membrane manufacturer.

3.19.2 In cavity wall construction, apply air/vapour barrier to exterior face of inner masonry exterior wall and foundation wythe; and over all surfaces occurring in that plane such as columns, piers, brackets and similar items, using propane torch in accordance with membrane manufacturer's directions. Cut and seal tightly around penetrations and protrusions so completed installation creates continuous air/vapour barrier in exterior wall and is sealed to all items occurring therein such as windows, door frames and sealed to roof air/vapour barrier membrane.

3.19.3 Lap joints minimum of 100 mm and fully heat seal. Seal around masonry reinforcement and other penetrations.

3.20 Cavity Insulation

3.20.1 Obtain Consultant's review of membrane application prior to placing insulation and on completion before constructing exterior wythe.

3.20.2 Place insulation in horizontal parallel courses tightly fitted between masonry reinforcement and in firm contact with air/vapour barrier and adjacent insulation panels with all edges buttered with air block.

3.20.3 Cut and fit insulation to provide complete unbroken installation with minimum joints. Fit insulation tightly around ties.

3.20.4 Install insulation retaining wedges. Ensure that wedge presses insulation in tight and firm contact with air/vapour barrier.

3.20.5 Where insulation cannot be secured by, wedges adhere with adhesives. Ensure full contact and adhesion to air/vapour barrier.

3.21 Engineered Masonry

3.21.1 Engineered masonry shall conform to CAN/CSA A371 and CSA S304 and to details as indicated on structural Drawings.

3.21.2 Repointing and Tuckpointing: Repoint defective joints as follows

.1 Cut back joints 13 mm taking care not to damage units. Remove dust and loose materials by brushing or by water jet. If water jet is used, allow excess water to drain before repointing.

.2 Repoint with same mix and colour as original.

.3 Pack mortar tightly in thin layers, and tool joint to match non-defective joints.

3.22 Tolerances

3.22.1 Tolerance to CAN/CSA A371.

3.22.2 Variation in vertical alignment: ±20mm (±3/4 in)

3.22.3 Variation in lateral alignment: ±13mm (±1/2 in)

3.22.4 Variation in level alignment - joints: ±13mm (±1/2 in)

3.22.5 Variation in relative alignment in 3m (10 ft): ±6mm (±1/4 in)

3.22.6 Variation of mortar joint thickness ±3mm (±1/8 in)

3.23 Field Quality Control

3.23.1 Inspection and Testing will be carried out in accordance with Section 01450, Quality Control.

3.23.2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

3.24 ProtecTion

3.24.1 Temporary Bracing

.1 Provide temporary bracing to masonry work during erection to prevent damage due to winds or other lateral loads until permanent structure provides adequate bracing.

3.24.2 Moisture Protection

.1 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.

.2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each workday. Anchor securely in position.

3.24.3 Air Temperature Protection: protect completed masonry as recommended in 1.9 EnvironmenTal Requirements.

3.24.1 Protect face work liable to become splashed or marked.

3.24.2 Construct and maintain temporary protection as required by varying weather conditions, to permit continuous progress of the work. Areas so protected shall be of sufficient size to

permit progress of all work necessary to maintain an orderly and efficient sequence of construction operations.

3.25 Cleaning

3.25.1 Clean in accordance with Section 01740- Cleaning.

3.25.2 Obtain cleaning materials manufacturer's instructions and brick manufacturer's written instructions for cleaning and verify cleaning procedures outlined in CAN/CSA A371 with manufacturers.

3.25.3 Test sample area, 10 m^2, to judge effectiveness of cleaning procedures and obtain Consultant's approval.

3.25.4 Keep wall clean and free of mortar stains during laying. Allow mortar droppings which adhere to wall to dry out but not set. Remove with trowel, then rub with small piece of masonry followed by brushing to remove all traces. On completion of masonry construction, after mortar is thoroughly set and cured, clean masonry thoroughly.

3.25.5 Protect windows, trim and metal from cleaning agents.

3.25.6 Remove mortar with wood paddles and scrapers before wetting. Saturate masonry with clean water and flush off loose mortar and dirt. Clean blockwork using water, scrubbing brushes and wood paddles only.

3.25.7 Clean masonry to be left exposed, using procedures as outlined herein and, where this is inadequate, follow recommendations outlined in Technical Notes on Brick Construction No. 20, revised Nov. 1990, published by the Brick Institute of America and distributed by Clay Brick Association of Canada. Should these methods prove inadequate consult masonry manufacturer before undertaking unusual cleaning procedures and obtain Consultant's prior consent.

END OF SECTION

1 GENERAL

1.1 General

1.1.1 Conform to Sections of Division 1 as applicable.

1.2 Related Sections

1.2.1 Section 04050 - Masonry Procedures

1.2.2 Section 04052 - Masonry Anchorage and Reinforcing

1.2.3 Section 04053 - Masonry Accessories

1.2.4 Section 04211 - Brick Unit Masonry

1.2.5 Section 04220 - Concrete Masonry Unit

1.2.6 Section 07840 - Fire Stopping

1.3 References

1.3.1 All products shall conform to the following standards and regulations:

.1 ASTM International (ASTM)

.1 ASTM C144-18 - Standard Specification for Aggregate for Masonry Mortar
.2 ASTM C150 / C150M-20 - Standard Specification for Portland Cement
.3 ASTM C207-18 - Standard Specification for Hydrated Lime for Masonry Purposes
.4 ASTM C270-19ae1 - Standard Specification for Mortar for Unit Masonry

.2 Canadian Standards Association (CSA):

.1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
.2 CAN/CSA A179-14 - Mortar and Grout for Unit Masonry
.3 CSA S304-14 - Design of Masonry Structures
.4 CAN/CSA A371-14 - Masonry Construction for Buildings
.5 CAN/CSA A3000-18 - Cementitious Materials Compendium

.3 Brick Industry Association (BIA) Technical Notes on Brick Construction

1.4 Submittals

1.4.1 Product Data

.1 Submit manufacturer's product data and installation instructions in accordance with Specification 01330 Submittals. Include product characteristics, performance criteria, and limitations.

.2 Submit digital PDF file format of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01300 Administration Requirements. Indicate the VOC content of mortar grout, parging, colour, additives, and admixtures.

1.4.2 Samples: prior to commencement of the Work submit samples in accordance with Section 01330, Submittals, and as follows;

.1 Submit one 500 ml size sample for each type and colour of mortar.

1.4.3 Test Reports:

.1 Submit test report for strength and colour of mortar.

1.5 Quality Assurance

1.5.1 Conform to requirements of CSA S304 for design requirements and for construction requirements to CAN/CSA A371 except where more stringent requirements are noted and/or indicated on Drawings and specified herein.

1.5.2 Certificates

.1 Submit manufacturer's signed certificate verifying that masonry mortars meet the performance characteristics and physical properties.

1.6 Delivery, Storage, and Handling

1.6.1 Deliver, store and handles masonry mortar and grout materials in accordance with Section-01610 – Basic Product Requirements supplemented as follows:

.1 Deliver prepackaged, dry-blended mortar mix to project site in labelled plastic-lined bags each bearing name and address of manufacturer, production codes or batch numbers, and colour or formula numbers.

.2 Maintain mortar, grout and packaged materials clean, dry, and protected against dampness, freezing, traffic and contamination by foreign materials.

1.7 Site Conditions

1.7.1 Ambient Conditions: maintain materials and surrounding air temperature to:

.1 Minimum 10 degrees C prior to, during, and 48 hours after completion of masonry work.

.2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.

1.7.2 Weather Requirements: CAN/CSA A371, International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Hot and Cold Weather Masonry Construction.

2 PRODUCTS

2.1 Approved Manufacturers

.1 King, A Sika Company, 555 Michigan Dr, Oakville, Ontario, L6L 0G4, Phone: (905) 639-2993, info@ca.sika.com, URL: can.sika.com Equivalent products may be submitted for Engineer's approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.2 Materials

2.2.1 Use same brands of materials and source of aggregate for entire project.

2.2.2 Mortar and Grout Materials: follow CAN/CSA A179

2.2.3 Aggregate: to CAN/CSA A179, except that the maximum allowable percentage passing 600 um (No. 30) sieve shall be 80 percent and maximum passing 300 um (No. 50) sieve shall be 50 percent.

2.2.4 Cement:

.1 Normal Portland: follow CAN/CSA A3000.

.2 Portland Cement: comply CAN/CSA A3000, Type GU - General use hydraulic cement (Type 10) grey colour.

.3 Masonry Cement: follow CAN/CSA A3000 and CAN/CSA A179, Type S.

.4 Mortar Cement: follow CAN/CSA A3000 and CAN/CSA A179, Type S.

.5 Packaged Dry Combined Materials for mortar: follow CAN/CSA A179, Type S, (using grey colour cement).

2.2.5 Aggregate: supplied by one supplier.

.1 Fine Aggregate: follow CAN/CSA A179, silica sand.

2.2.6 Water: clean and potable.

2.2.7 Lime:

.1 Quick Lime: follow CAN/CSA A179, Type S

.2 Hydrated Lime: follow CAN/CSA A179, Type S

2.2.8 Bonding Agent: latex type

2.2.9 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

2.2.10 Proprietary Mortar and grout Mixes: Use preblended and prepackaged products

2.2.11 Non-Staining mortar: use non-staining masonry cement for cementitious portion of specified mortar type.

2.2.12 Grout: to CAN/CSA A179, Table 5

2.2.13 Pre Blended Mortars; to CAN/CSA A179; for use in all types of masonry, stone, tile, terra-cotta and limestone, cement based waterproof pointing mortar, non-staining, high strength; permeability and strength can be customized to suit project.

.1 Acceptable Products

.1 Type S King 2-1-9 as manufactured by King, A Sika Company
.2 or approved equal.

2.2.14 Pre Blended Grout; to CAN/CSA A179, for sealing pores and shrinkage cracks in mortar joints and for filling concrete block cells.

.1 Acceptable Products

.1 CellFiller E-20 as manufactured by King, A Sika Company or approved equal.

2.2.15 Grout (grout for grouted cores): Portland Cement Concrete Grout, 20 MPa

2.2.16 Mortar and concrete will not be accepted as alternatives to grout.

2.3 Colour Additives

2.3.1 Mortar Colouring Compounds: Pure, synthetic, or organic pigments, in proportions recommended by manufacturer, but not exceeding 10% of cement content by mass. Match approved sample. Use coloured mortar at all stone unit masonry locations.

.1 Acceptable Manufacturers

.1 Solomon Colours, Inc.

2.3.2 Portland Cement Mortar Colour: 35A.

2.4 Mixes

2.4.1 Mixing Method 1: Prepare and mix mortar materials under strict supervision, and in small batches for immediate use only. Use and mix proprietary mortar, and use and store ready mixed mortars, in strict accordance with manufacturer's instructions to produce following mortar types, CAN/CSA A179-14. Do not use retempered mortars except for ready mixed mortar, which shall be retempered in accordance with manufacturer's instructions. Mixed mortar shall be discarded after two (2) hours.

2.4.2 Mortar for exterior masonry above grade:

.1 For loadbearing and non-loadbearing Stone and Faceblock: Use proprietary or ready mixed type "S" masonry mortar mixes specified, mixed in accordance with manufacturer's instructions.

2.4.3 Mortar for interior masonry:

.1 For Loadbearing Stone and Faceblock: Use proprietary or ready mixed type "S" masonry mortar mixes specified, mixed in accordance with manufacturer's instructions.

.2 For non-Loadbearing Stone and Faceblock: Use proprietary or ready-mixed type "N" masonry mortar mixes specified, mixed in accordance with manufacturer's instructions.

2.4.4 For Bedding Steel Bearing Plates, Lintels, for Laying Bearing Courses Under Concentrated Loads and for Laying Masonry Below Grade: Use Type 'M' cement mortar, having a compressive strength of 20.0 MPa minimum.

2.4.5 Portland Cement: Type I in accordance with ASTM C150/C150M. If a waterproof Portland Cement is used, the integral type waterproofer shall be omitted. Color: Grey

2.4.6 Lime: Shall be a dolomitic pressure-hydrated lime, special hydrate, Type S, in accordance with ASTM C207.

2.4.7 Sand: A clean, white quartzite or silica type, essentially free of iron compounds, in accordance with ASTM C144, not less than 100% passing a No. 8 sieve.

2.5 Mortar Mixing

2.5.1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.

2.5.2 Mix mortar ingredients in accordance with CAN/CSA A179 in quantities needed for immediate use.

2.5.3 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.

2.5.4 Do not add air entraining admixture to mortar mix.

2.5.5 Use a batch type mixer in accordance with CAN/CSA A179.

2.5.6 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.

2.5.7 Use mortar within 2 hours after mixing at temperatures of 32 degrees C, or 2.5 hours at temperatures under 10 degrees C.

2.6 Grout Mixes

2.6.1 Bond Beams and Block Lintels: grout mix 20 MPa strength at 28 days; 200-250 mm slump; premixed type in accordance with CAN/CSA A23.1/A23.2 mixed in accordance with CAN/CSA A179 fine grout.

2.6.2 Grouted Cores: Minimum compressive strength of 20 MPa at 28 days. Maximum aggregate size and grout slump: CAN/CSA A179.

2.7 Grout Mixing

2.7.1 Mix batched and delivered grout in accordance with CSA A23.1/A23.2 pre-blended under factory controlled conditions.

2.7.2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA A179 fine grout.

2.7.3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.

2.7.4 Do not use calcium chloride or chloride based admixtures.

2.8 Mix Tests

2.8.1 Testing Mortar Mix:

.1 Test mortar to requirements of Section 01450 - Quality Control, and in accordance with CAN/CSA A179, for mortar based on property specification. Test prior to construction and during construction for:

.1 Compressive strength.
.2 Consistency.

.2 Testing Grout Mix:

.1 Test grout to requirements of Section 01450 - Quality Control, and in accordance with CAN/CSA A179, for grout based on property specification. Test prior to construction and during construction for:
.2 Compressive strength.
.3 Slump.

3 EXECUTION

3.1 Examination

3.1.1 Request inspection of spaces to be grouted.

3.2 Preparation

3.2.1 Apply bonding agent to existing concrete surfaces.

3.2.2 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 Manufacturer's Instructions

3.3.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.4 Installation

3.4.1 Do masonry mortar and Grout work in accordance with CAN/CSA A179 except where specified otherwise.

3.4.2 Repointing and Tuckpointing: Repoint defective joints as follows:

.1 Cut back joints 13 mm taking care not to damage units. Remove dust and loose materials by brushing or by water jet. If water jet is used, allow excess water to drain before repointing.

.2 Repoint with preblended prepackaged mortar mix based on proportion specification..

.3 Pack mortar tightly in thin layers, and tool joint to match non-defective joints.

3.5 Mixing

3.5.1 Clean all mixing boards and mechanical mixing machine between batches.

3.5.2 Mortar must be weaker than the units it is binding.

3.5.3 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

3.6 Mortar Placement

3.6.1 Install mortar, premix mortar to manufacturer's instructions.

3.6.2 Install mortar and grout to requirements of CAN/CSA A179.

3.6.3 Remove excess mortar from grout spaces.

3.7 Grout Placement

3.7.1 Install grout in accordance with manufacturer's instructions.

3.7.2 Install grout in accordance with CAN/CSA A179.

3.7.3 Work grout into masonry cores and cavities to eliminate voids.

3.7.4 Do not install grout in lifts greater than 1500 mm, or 2400 mm high lifts where cleanouts are provided, without consolidating grout by rodding or vibrating.

3.7.5 Do not displace reinforcement while placing grout.

3.8 Field Quality Control

3.8.1 Site Tests, Inspection: in accordance with Section 04050 - Masonry Procedures supplemented as follows:

.1 Test and evaluate mortar prior to construction and during construction in accordance with CAN/CSA A179.

.2 Test and evaluate grout prior to construction and during construction to CAN/CSA A179; test in conjunction with masonry unit sections specified.

3.8.2 Manufacturer's Field Services: in accordance with Section 04050 - Masonry Procedures.

3.9 Cleaning

3.9.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.9.2 Remove droppings and splashings using clean sponge and water.

3.9.3 Clean masonry with low pressure clean water and soft natural bristle brush.

3.10 Protection of Completed Work

3.10.1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

1 GENERAL

1.1 General

1.1.1 Conform to Sections of Division 1 as applicable.

1.2 Related Sections

1.2.1 Section 03200 – Concrete Reinforcement.

1.2.2 Section 03300 – Cast-in-Place Concrete.

1.2.3 Section 04050 - Masonry Procedures

1.2.4 Section 04053 - Masonry Accessories

1.2.5 Section 05120 - Structural Steel

1.2.6 Section 05500 - Metal Fabrications.

1.2.7 Section 07840 - Fire Stopping.

1.2.8 Section 07900 – Joint Sealants.

1.3 References

1.3.1 All products shall conform to the following standards and regulations:

.1 ASTM International (ASTM).

.1 ASTM A123/A123M-17 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A153/A153M-16a - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

.3 ASTM A580/A580M- 18 - Standard Specification for Stainless Steel Wire

.4 ASTM A666-15 - Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar

.5 ASTM A951/A951M-16e1 - Standard Specification for Steel Wire for Masonry Joint Reinforcement

.6 ASTM A1064/A1064M-18a - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

.2 Canadian Standards Association (CSA)

.1 CAN/CSA-A3000-18 - Cementitious Materials Compendium

.2 CAN/CSA A179-14 - Mortar and Grout for Unit Masonry

.3 CAN/CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels

.4 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete

.5 CSA A165 Series-14 – CSA Standards on Concrete Masonry Units

.6 CSA A370-14 (R2018) - Connectors for Masonry

.7 CAN/CSA A371-14 - Masonry Construction for Buildings

.8 CSA G30.18-09 (R2014) - Carbon Steel Bars for Concrete Reinforcement

.9 CSA S304-14 - Design of Masonry Structures

.3 Brick Institute of America (BIA) Technical Notes on Brick Construction.

1.4 Submittals

1.4.1 Product Data: submit manufacturers' MSDS product data sheets for epoxy coatings, and galvanized protective coatings. Indicating VOC content.

1.4.2 Submit vertical reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada outlined in Section 03200.

1.5 Quality Assurance

1.5.1 Certificates: Submit manufacturer's certificate verifying that masonry reinforcement supplied to project conforms to ASTM A153/A153M; Class B2 hot dipped galvanized requirements. Submit manufacturer's certificate verifying that stainless steel masonry reinforcement is type 304/316 and conforms to ASTM A580/A580M wire ties/ reinforcing and ASTM A666 plates/strips/sheets.

1.5.2 Conform to requirements of CSA S304 for design requirements and for construction requirements to CSA A370, CAN/CSA A371 except where more stringent requirements are noted and/or indicated on Drawings and specified herein.

1.5.3 Conform to CSA A371 for temporary wind bracing for masonry during construction.

.1 Provide temporary bracing for masonry work during erection to prevent damage due to winds or other lateral loads until permanent structure provides adequate bracing.

2 PRODUCTS

2.1 Materials

2.1.1 Bar Reinforcement: to CAN/CSA A371 and CSA G30.18, Grade 400.

2.1.2 Wire reinforcement: to CAN/CSA A371 and ASTM A951/A951M.

2.1.3 Connectors: to CSA A370 and with corrosion protection to CSA A304.1, and as follows;

.1 Mill Galvanized: For interior masonry not subject to moisture.

.2 Hot Dip Galvanized: For interior masonry subject to moisture, below grade masonry in contact with ground and above grade exterior masonry. In buildings less than 11 m in height; hot dip galvanized after fabrication with min zinc coating in accordance with ASTM A153/A153M, Class B for wire ties/reinforcing 458 g/m² (1.5 oz/f²) and ASTM A123/A123M for plates/strips/sheets 610 g/m² (on each face).

.3 Masonry Reinforcement for Non-Cavity Walls: 4.8 mm diameter sized 50 mm narrower than wall or partition. Provide shop fabricated corners and intersections and curved configuration where required. Finish as specified herein before depending upon location of walls.

.1 Acceptable Products

.1 Hohmann and Barnard, Inc., 220 Ladder – Mesh SHD; supplied by Brock White Canada

.2 Blok Lok Ltd., BL-10 EHD

.3 JV Building Products, WL-10 EHD

.4 Approved Equivalent

.4 Interior and Exterior Cavity Walls and Composite Walls

.1 For tying brick, concrete block and stone veneers to concrete block use Fero Block Shear Tie as supplied by FERO Corporation1-877-703-4463, in combination with 2-wire ladder horizontal reinforcing 4.8 mm diameter wire side and cross rods. The Fero Block Shear length shall suit concrete block (inner wythe) width and thickness of insulation. The Fero V-Tie shall be of length to provide placement of V-tie legs at centreline of veneer (outer wythe). Provide Block Shear Ties at 800 mm horizontal x 600 mm vertical spacing and 300 mm maximum spacing around wall openings, top, base and corners or as noted on drawings.

.2 For tying brick, concrete block and stone veneers to cast in place concrete and structural steel use Fero RAP Ties as supplied by FERO Corporation, fastened to backup with U-CAN fastener. The Fero RAP plate length shall suit thickness of insulation. The Fero V-tie shall be of length to provide placement of V-tie legs at the centreline of veneer (outer wythe). Provide RAP ties at 600 mm x 600 mm spacing and 300 mm maximum spacing around wall openings, top, base and corners or as noted on drawings.

.1 For tying brick, concrete block and stone to structural columns and beams, use Fero CAT tie as supplied by FERO Corporation, attached with UCAN fasteners. The Fero V-ties shall be of length to provide placement at the centreline of veneer (outer wythe). Provide CAT ties as shown on drawings.

.2 For tying brick, concrete block and stone veneers to metal studs, use Fero Side Mounting RAP Ties as supplied by FERO Corporation, attached to the side of stud with U-CAN fasteners. The Fero Side Mounting RAP Plate length to suit width of metal stud and thickness of sheathing/insulation. The Fero V-ties shall be of length to provide placement of V-ties at the centreline of veneer. Provide Side Mounting RAP ties at 400 mm horizontal x 600 mm vertical spacing and 300

mm maximum spacing around wall openings, top, base and corners or as noted on drawings.

.3 Fero Plastic Insulation Support.

.4 All metal components: hot dipped zinc galvanized after fabrication.

2.1.7 Vertical Bar reinforcement: Steel to CAN/CSA A371 and CAN/CSA G30.18, Grade 400:

.1 All load bearing walls to have 15M bars at 600 mm O.C. minimum, in fully grouted cores, unless noted otherwise on drawings.

.2 All non-load bearing walls to have 15M bars at 800 mm O.C. minimum, in fully grouted cores, unless noted otherwise on drawings.

.3 All 15M vertical bars are to have matching lapping 15M dowels, ~~1200~~1350 mm long, embedded 600 mm into the foundation walls.

.4 Refer to structural drawings for additional reinforcing steel locations.

2.1.8 Horizontal Bar reinforcement: Steel to CAN/CSA A371 and CAN/CSA G30.18, Grade 400:

.1 All bond beams to be minimum 400 mm deep and to have 1-15 M T& B bars minimum unless noted otherwise, in a fully grouted bond beam course.

2.1.9 Interior Concrete Block Joint Reinforcement to CSA-G30.3.

.1 Use galvanized steel wire ladder type joint reinforcement. Acceptable system: Blok-Lok BL42 as manufactured by Blok-Lok.

.2 Non-Load bearing Interior Partition Walls: Use Block-Lok BL10, 4.8 mm dia. wires every second course.

.3 Wall Corners and Intersections: Use prefabricated corner and tee reinforcing.

2.1.10 Masonry to masonry at infill conditions: galvanized, corrugated steel.

2.1.11 Corrosion protection: to CSA-S304.1, galvanized to CSA-S304.1 and CAN/CSA A370.

2.1.12 Fasteners: installed post-construction:

.1 Bolts and Screws: size and type to suit application, locate where indicated.

.2 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.

.3 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.

.4 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.

2.1.13 Adhesive Anchors: proprietary systems, pre-mixed, self-contained system with double glass vial system to contain epoxy, consisting of resin, hardener and aggregate.

2.2 Fabrication

2.2.1 Fabricate reinforcing in accordance with CSA A23.1 and Reinforcing Steel Manual of Standard Practice and Reinforcing Steel Institute of Ontario

2.2.2 Fabricate connectors in accordance with CSA A370.

2.2.3 Obtain engineer approval for locations of splices not shown on placing diagrams.

2.2.4 Lintels: Fabricate steel lintels as indicated on Drawings.

3 EXECUTION

3.1 Installation

3.1.1 General

.1 Do masonry reinforcement and connectors in accordance with CSA A370, CAN/CSA A371, CSA A23.1/A23.2, and CSA S304.1 unless indicated otherwise.

.2 Do masonry work in accordance with Section 04050 – Masonry Procedures

3.1.2 Continuous Horizontal Reinforcement and Reinforcing Ties

.1 Reinforce all exterior face masonry with Fero shear connectors, including insulation clips to suit wall construction.

.2 Reinforce all masonry walls with continuous masonry wall reinforcement in every second block.

.3 Adjustable masonry reinforcement not permitted to correct poorly laid masonry. Bending of masonry reinforcement or ties are not permitted.

.4 At corners of openings, provide extra masonry/cavity wall reinforcement, so that first and second courses above and below openings are reinforced. Extend extra reinforcement 600 mm (2') beyond opening in each direction.

.5 Non-conventional Ties

.1 Not Used.

3.1.3 Engineered Masonry: Engineered masonry shall conform to CAN/CSA A371 and CSA A304 and to details as indicated on structural Drawings.

.1 Install masonry wall base anchors in masonry foundation walls to line up with voids in masonry walls above as indicated on Drawings. Solidly fill voids between anchors and masonry with mortar.

3.1.4 Lintels and Bond Beams

.1 Reinforce masonry lintels and bond beams as indicated.

.2 Bond beam shall be provided at the top of all load bearing masonry walls.

.3 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA A371 and CAN/CSA A179.

3.1.5 Anchors

.1 Supply and install metal anchors as indicated on drawings.

.2 Supply and install lateral support and anchorage in accordance with CSA S304.1

3.2 Setting and Building-In

3.2.1 Refer to section 04050 – Masonry Procedures

3.3 Field Touch-Up

3.3.1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant. Replace damaged bars and connectors.

3.3.2 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide a continuous coating. Ensure touch-up coating meets VOC limit requirements.

END OF SECTION

1 GENERAL

1.1 General

1.1.1 Conform to Sections of Division 1 as applicable.

1.2 Related Sections

1.2.1 Section 04050 - Masonry Procedures

1.2.2 Section 04051 – Masonry Mortar and Grout

1.2.3 Section 04052 - Masonry Anchorage and Reinforcing

1.2.4 Section 04220 – Concrete Masonry Unit

1.2.5 Section 07840 - Fire Stopping

1.3 References

1.3.1 All products shall conform to the following standards and regulations:

.1 Canadian Standards Association (CSA)

.1 CAN/CSA A3000-18 - Cementitious Materials Compendium
.2 CAN/CSA A179-14 - Mortar and Grout for Unit Masonry
.3 CAN/CSA A371-14 - Masonry Construction for Buildings
.4 CSA S304-14 - Design of Masonry Structures

.2 American Society for Testing and Materials (ASTM):

.1 ASTM D146 / D146M - 04(2020) - Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
.2 ASTM D1056 – 20 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
.3 ASTM D3019 / D3019M – 17 – Standard Specification for Lap Cement Used with Asphalt Roll Roofing, Non-Fibered, Asbestos-Fibered, and Non-Asbestos Fibered
.4 ASTM D3575 - Standard Test Methods for Flexible Cellular Materials Made from Olefin Polymers

.3 The Brick Industry Association (BIA) - Technical Notes on Brick Construction

1.4 Submittals

1.4.1 Product Data:

.1 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01330 – Submittal Procedures. Indicate the VOC content of mortar grout, parging, colour, additives, and admixtures.

1.5 Quality Assurance

1.5.1 Certificates:

.1 Submit manufacturer's signed certificate verifying that masonry mortars meet the performance characteristics and physical properties.

2 PRODUCTS

2.1 Materials

2.1.1 Thru-Wall Flashing and Dampcourse for Walls: Modified bitumen membrane reinforced with fibreglass scrim 12.7 mm x 12.7 mm, minimum thickness 1.2 mm (47 mils).

.1 Acceptable Products

.1 Soprema Waterproofing Inc. - Sopraseal 60
.2 Bakor Inc.- Blueskin TWF
.3 or approved equal.

2.1.2 Adhesive for Dampcourse and Flashing: Single component of trowel consistency, synthetic rubber based adhesive.

.1 Acceptable Product

.1 Soprema - Sopraseal LM 200 T
.2 Bakor Inc. - Air-Block 21
.3 Or approved equal

2.1.3 Weep Hole Vents: Polyvinyl (PVC) brick vents, of standard size 64mm tall, size and colour to suit masonry veneer.

.1 Acceptable Products

.1 Goodco Ltd. - Polyvinyl
.2 Guy Guenette Ltee/Ltd. - Stainless steel weep holes No. 20
.3 Blok-Lok Ltd. - Cell Vent

.2 Mortar Dropping Control Device: 25 mm thickness.

.1 Acceptable Products
.1 JV Building Materials - MortarNet
.2 Blok-Lok Ltd. - Mortar Trap
.3 Horman & Barnard Inc - Mortar Mitt
.4 Cavity Net DT – Wire Bond

2.1.4 Expansion Joint Flashing: Polyvinyl chloride of profile indicated on Drawings

2.1.5 Control Joints

.1 Control joint material to match colour of brick grout.

.2 Bond Breaker: perforated asphalt building paper to ASTM D146 with minimum tensile strength of 5.25kN/m (MD) and 2.63kN/m (XD).

.1 Acceptable Products
.1 BP – No. 15 Perforated Asphalt Saturated Felt
.2 HAL – No. 15 Perforated Asphalt Saturated Felt
.3 IKO – No. 15 Perforated Asphalt Saturated Felt

.3 Compressed Joint Filler: polyethylene, closed-cell to ASTM D3575

.1 Acceptable Products

.1 W.R. Meadows SealTight – Deck-O-Foams
.2 Reflectix Inc – Expansion Joint
.3 Norseman – Nor-Flex 100

.4 Compressed Joint Filler: Closed cell Neoprene Sponge to ASTM D-1056 Grade 2A 1

.1 Acceptable Products
.1 Blok-lok - NS Neoprene Sponge
.2 Or approved equivalent

3 EXECUTION

3.1 Installation

3.1.1 Install continuous control joint fillers in control joints at locations indicated on drawings.

3.1.2 Install weep hole vents in vertical joints immediately over flashings in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 800 mm on centers.

3.1.3 Install cavity vents at top of cavity space with spacing as indicated on drawings.

3.2 Flashing

3.2.1 Build in flashing in masonry in accordance with CAN/CSA A371.

3.2.2 Install flashings under exterior bearing of masonry walls, slabs, shelf angles and steel angles over openings.

3.2.3 Install flashings under weep hole courses and as indicated.

3.2.4 Cavity and Veneer Walls: carry flashing from front edge of masonry, under outer wythe, return backing up not less than 150 mm and as follows:

.1 masonry backing: embed flashing 25 mm in joint

.2 concrete: insert flashing into reglets

.3 wood frame: staple to wall behind sheathing

.4 sheathing: bond to wall with adhesive recommended by manufacturer

3.3 Cleaning

3.3.1 Clean in accordance with Section 01740- Cleaning.

END OF SECTION

1 GENERAL

1.1 Related Sections

1.1.1 Section 04050 – Masonry Procedures

1.1.2 Section 04051 – Masonry Mortar and Grout

1.1.3 Section 04052 - Masonry Anchorage and Reinforcing

1.1.4 Section 04053 – Masonry Accessories

1.1.5 Section 04220 – Concrete Masonry Units

1.2 References

1.2.1 American Society for Testing and Materials (ASTM).

.1 ASTM C73-17, Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).

.2 ASTM C126-19 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units

1.2.2 Brick Industry Association (BIA)

.1 Technical Note No. 20, Cleaning Brick Work.

1.2.3 Canadian Standards Association (CSA).

.1 CAN/CSA-A82-14 - Fired Masonry Brick Made From Clay or Shale

.2 CAN/CSA-A165 Series-04 (R2014) - CSA Standards on Concrete Masonry Units

.3 CSA A371-14 - Masonry Construction for Buildings.

1.3 Shop Drawing Submittals

1.3.1 Provide submittals in accordance with Section 01330 - Submittals.

1.3.2 Product Data:

.1 Product Data: provide product data, including manufacturer's printed data sheets and catalog pages illustrating products to be incorporated into project for specified products.

1.3.3 Samples:

.1 Provide unit samples in accordance with Section 04050 - Masonry Procedures.

.2 Manufacturer's Written Instructions: provide in accordance with Section 04050 - Masonry Procedures.

1.4 Quality Assurance

1.4.1 Certificates: provide in accordance with Section 04050 - Masonry Procedures

1.4.2 Test and Evaluation Reports: provide certified test reports in accordance with Section 04050 - Masonry Procedures.

1.4.3 Pre-Installation Meetings: conduct pre-installation meeting in accordance with Section 04050 - Masonry Procedures to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 Shop Drawing Submittals

1.5.1 Provide submittals in accordance with Section 01330 - Submittals.

1.5.2 Product Data:

.1 Product Data: provide product data, including manufacturer's printed data sheets and catalog pages illustrating products to be incorporated into project for specified products.

1.5.3 Samples:

.1 Provide unit samples in accordance with Section 04050 - Masonry Procedures

1.5.4 Manufacturer's Written Instructions: provide in accordance with Section 04050 - Masonry Procedures.

1.6 Delivery, Storage, and Handling

1.6.1 Deliver, store and handle concrete unit masonry in accordance with Section 04050 - Masonry Procedures.

2 PRODUCTS

2.1 Manufactured Units

2.1.1 Face brick:

.1 Hollow clay brick: to CAN/CSA-A82

.1 Type: S
.2 Grade: EG
.3 Size: Standard Modular
.4 Colour: To be determined

2.2 Reinforcement

2.2.1 Reinforcement in accordance with Section 04052 - Masonry Anchorage and Reinforcing.

2.3 Connectors

2.3.1 Connectors in accordance with Section 04052 - Masonry Anchorage and Reinforcing.

2.4 Flashing

2.4.1 Flashing: in accordance with Section 04053 - Masonry Accessories.

2.5 Mortar Mixes

2.5.1 Mortar and mortar mixes in accordance with Section 04051 - Masonry Mortar and Grout.

2.6 Grout Mixes

2.6.1 Grout and grout mixes in accordance with Section 04051 - Masonry Mortar and Grout.

2.7 Control Joints

2.7.1 Control joints in accordance with Section 04053 – Masonry Accessories.

3 EXECUTION

3.1 Examination

3.1.1 Verify surfaces and conditions are ready to accept work of this Section.

3.1.2 Commencing installation means acceptance of existing substrates.

3.2 Preparation

3.2.1 Protect adjacent finished materials from damage due to masonry work.

3.3 Installation

3.3.1 Construction to conform to CSA A371.

3.3.2 Bond: Running Bond and Soldier Course refer to elevations for location

3.3.3 Coursing height:

.1 Premier Plus - 800 mm for nine (9) bricks and nine (9) joints as indicated.

.2 Modular / Norman - 200 mm for three (3) bricks and three (3) joints

.3 Jumbo - 200 mm for two (2) bricks and three (2) joints

3.3.4 Jointing: concave where exposed or where paint or similar thin finish coating is specified, unless specified otherwise.

3.3.5 Mixing and blending: mix units within each pallet and with other pallets to ensure uniform blend of colour and texture.

3.3.6 Clean unglazed clay masonry as work progresses.

3.4 Field Quality Control

3.4.1 Site Tests, Inspection: in accordance with Section 04050 – Masonry Procedure.

3.5 Cleaning

3.5.1 Clean unglazed clay masonry: 10 m² area of wall designated by Engineer mock-up panel specified in Section 04510 – Masonry Procedures as directed below and leave for one (1) week. If no harmful effects appear and after mortar has set and cured, protect windows, sills, doors, trim and other work and clean brick masonry as follows:

3.5.2 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.

3.5.3 Scrub with solution of 25 ml trisodium phosphate and 25 ml household detergent dissolved in 1 litre of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternately, use proprietary compound recommended by brick masonry manufacturer in accordance with manufacturer's directions.

3.5.4 Repeat cleaning process as often as necessary to remove mortar and other stains.

3.5.5 Use acid solution treatment for difficult to clean masonry as described in Technical Note No. 20 published by The Brick Industry Association, dated June 2006.

3.5.6 Clean concrete brick masonry as work progresses.

.1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of brick and, finally, by brushing.

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 Provision and installation of concrete masonry units.

1.2 Related Sections

1.2.1 Conform to Sections of Division 1 as applicable

.1 Section 03200 Concrete Reinforcement

.2 Section 04050 Masonry Procedures

.3 Section 04051 Masonry Mortar and Grout

.4 Section 04052 Masonry Anchorage and Reinforcing

.5 Section 04053 Masonry Accessories

.6 Section 05120 Structural Steel

.7 Section 07620 Sheet Metal Flashing and Trim

.8 Section 07840 Fire Stopping

.9 Section 07900 Joint Sealants

1.3 References

1.3.1 ASTM International Inc.

.1 ASTM C207-18 - Standard Specification for Hydrated Lime for Masonry Purposes

.2 ASTM C331/C331M-17 - Standard Specification for Lightweight aggregates for Concrete Masonry Units

.3 ASTM E514/E514M-14a - Standard Test Method for Water Penetration and Leakage Through Masonry.

.4 ASTM A123M / A123M-17 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products

1.3.2 Canadian Standards Association (CSA International)

.1 CAN/CSA A3000-18 - Cementitious Materials Compendium

.2 CAN/CSA A165 Series-14 - Concrete Masonry Units

.3 CAN/CSA-A179-14 - Mortar and Grout for Unit Masonry

.4 CSA A370-14 - Connectors for Masonry

.5 CAN/CSA A371-14 - Masonry Construction for Buildings

.6 CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel

.7 CSA S304-14 - Design of Masonry Structures

1.3.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S101-14 - Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3.4 Brick Institute of America (BIA)

.1 The Brick Industry Association (BIA) - Technical Notes on Brick Construction.

1.4 Quality Assurance

1.4.1 Certificates: provide in accordance with Section 04050 - Masonry Procedures

1.4.2 Test and Evaluation Reports: provide certified test reports in accordance with Section 04050 - Masonry Procedures.

1.4.3 Pre-Installation Meetings: conduct pre-installation meeting in accordance with Section 04050 - Masonry Procedures to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 Shop Drawing Submittals

1.5.1 Provide submittals in accordance with Section 01330 - Submittals.

1.5.2 Product Data:

.1 Product Data: provide product data, including manufacturer's printed data sheets and catalog pages illustrating products to be incorporated into project for specified products.

2. Scaled masonry wall elevations with the following information:

.1 Block arrangement, wall thickness
.2 Core fills
.3 Rebar, rebar designation, laps, dowels, and anchors
.4 Openings and lintels
.5 Bond beam and horizontal reinforcement
.6 Control joint location and extent

1.5.3 Samples:

.1 Provide unit samples in accordance with Section 04050 - Masonry Procedures

.2 Manufacturer's Written Instructions: provide in accordance with Section 04050 - Masonry Procedures.

1.6 Delivery, Storage, and Handling

1.6.1 Deliver, store and handle concrete unit masonry in accordance with Section 04050 - Masonry Procedures.

2 PRODUCTS

2.1 Materials

2.1.1 Concrete Block: Modular, CSA A165 and as follows:

.1 H/15/A/M, filled solid for top two courses of load bearing walls, for all locations where structural members bear on concrete block, and where indicated on Drawings.

.2 H/15/C/M or H/15/D/M for all other locations with width greater than 140mm

.3 SS/15/C/M for all sections with widths of or less than 140mm.

.4 Provide special shapes and sizes as indicated or specified such as halves, jambs, lintels, solids, corners, bullnoses and double bullnoses, semi-solids, and other shapes. Use only bull-nosed units with full and complete radius with no vertical ridge.

.5 Use normal weight concrete where finished face exposed to exterior or to earth below grade.

.6 Where concrete block walls are required to act as fire separations or barriers, provide blocks conforming to OBC with respect to classification, thickness, fire resistant ratings and type of concrete.

.7 Exposed block shall be uniform in colour, shade and texture, and made by one manufacturer.

2.2 Reinforcement and Connectors

2.2.1 Reinforcement and connectors in accordance with Section 04052 - Masonry Anchorage and Reinforcing.

2.3 Mortar and Grout Mixes

2.3.1 Mortar, mortar mixes and grout mixes in accordance with Section 04051 - Masonry Mortar and Grout.

2.4 Flashing and Control Joints

2.4.1 Flashing and control joints in accordance with Section 04053 – Masonry Accessories.

2.5 Cleaning Compounds

2.5.1 Compatible with substrate and acceptable to masonry manufacturer for use on products.

2.5.2 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.6 Tolerances

2.6.1 Tolerances for standard concrete unit masonry and architectural concrete masonry units in accordance with CAN/CSA A165, supplemented as follows:

.1 Maximum variation between units within specific job lot not to exceed 2 mm.

.2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.

.3 Out of square tolerance not to exceed 2 mm.

.4 Maximum variation in width between architectural concrete masonry units within specific job lot for specified dimension not to exceed 2 mm.

3 EXECUTION

3.1 Examination

3.1.1 Verify surfaces and conditions are ready to accept work of this Section.

3.1.2 Commencing installation means acceptance of existing substrates.

3.2 Preparation

3.2.1 Protect adjacent finished materials from damage due to masonry work.

3.3 Installation

3.3.1 Concrete block units:

.1 Bond: running.

.2 Coursing height: 200 mm for one block and one joint.

.3 Jointing: concave where exposed or where paint or other finish coating is specified.

3.3.2 Special Shapes:

.1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.

.2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.

.1 End bearing: not less than 200 mm or as indicated on drawings whichever is greater.

3.3.3 Reinforcement and connectors:

.1 Install reinforcing and connectors in accordance with Section 04052 - Masonry Anchorage and Reinforcing.

3.3.4 Mortar and grout Placement:

.1 Place mortar and grout in accordance with Section 04051 - Masonry Mortar and Grout.

3.3.5 Flashing and control joints:

.1 Install flashings and control joints in accordance with Section 04053 - Masonry Accessories.

3.3.6 Construction

.1 Construct concrete masonry units in accordance with section 04050 – Masonry Procedures

.2 Maintain dimensions, lines and levels.

.3 When mortar is "thumb-print" hard, tool joints slightly concave for exposed work; elsewhere, strike joints flush. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess material or burrs left after jointing. Use trowel or rub with burlap bag.

.4 Lay all joints approximately 10 mm thick unless otherwise specified or otherwise indicated on Drawings. Fill joints full of mortar except where specifically designated to be left open.

.5 Provide exterior inspection ports in cavity walls by leaving out every 6th brick (or 3rd block) of first course over all dampproof courses and flashings until wall panel supported by that course of units is constructed and reviewed. Clean cavity and obtain Consultant's review prior to filling inspection ports to match adjacent masonry.

.6 Use bullnose and double bullnose block at all external corners where block is left exposed.

3.3.7 Blockwork

.1 Lay block to align plumb over each other with thick ends of webs up. Leave no cells open in exposed work. Reinforce all blockwork as hereinafter specified.

.2 Minimize cutting block. Cut exposed block with power driven abrasive cutting disc or diamond cutting wheel where cutting is required and for flush mounted electrical outlets, grilles, pipes, conduit, leaving 3 mm maximum clearance

.3 Do not wet concrete masonry before or during laying in wall.

.4 Locate corners accurately.

.5 Use full bed of mortar for first course. For remaining courses bed face shells and vertical end joints fully in mortar. Compress joint mortar to thumb print hard.

.6 Stagger end joints in every course. Align joints plumb over each other in every other course.

.7 Install weep hole vents at bottom of outer wythes in cavity walls and over all dampcourses and flashings therein. Space not more than 800 mm o.c. horizontally or every second block. Ensure that vents are not plugged with mortar or debris.

.8 Bond intersecting block walls in alternate courses with metal anchors. Where blockwork abuts concrete, bond each block course with dovetail anchors.

.9 Where exterior wall backup block inner wythe coursing does not line up with masonry veneer or outer wythe coursing, bond with adjustable reinforcement to Code requirements every 600 mm.

.10 Do not break bond of corridor walls or other walls of exposed units where partitions intersect and if bonding would show through on exposed face of walls. Bond these partitions, to walls they intersect, with prefabricated intersection masonry anchor reinforcement in each course.

.11 For cavity wall construct inner wythe to full required or panel height with full joints struck flush on cavity side before proceeding with balance of cavity wall construction.

.12 Distribute units of varying colour and texture where walls are exposed. Ensure that quality monolithic appearance is achieved. Do not use units that contrast greatly from overall range.

3.3.8 Interior Load Bearing and Non-Load bearing Partitions

.1 Carry loadbearing partitions at stair wells and elevator walls, at mechanical and at electrical shafts to structure above, wedge and grout. (i.e., to underside of floor and roof slabs and to structural framing). Rake out full mortar joint between partition and structure for a depth of 13 mm on one (1) side for sealing specified under Section 07900, Joint Sealants. Rake joint shall be on side of suspended ceiling (if any). If no ceiling then on side as directed.

.2 Carry non-loadbearing partitions such as corridor partitions, demising partitions, partitions in areas without suspended ceilings and other partitions so indicated on Drawings, up through ceiling to structure above, unless indicated or specified otherwise. Terminate such partitions 19 mm below structure and fill space between top of masonry and structure with compressed packing insulation.

.3 Co-ordinate bracing to provide lateral support for tops of partitions required to extend to within 19 mm of underside of structure where they occur under steel joists and beams, slabs and other structural elements with Section 05500 – Metal Fabrications.

.4 Where walls and partitions are pierced by structural members, ducts, pipes, fill voids with mortar within 19 mm of such items flush with wall finish.

.5 Fill spaces between partition and structure, ducts and pipes with compressed packing insulation completely from one side of wall to other.

3.3.9 Load Bearing Walls

.1 Wedge and grout load bearing walls to underside of structure.

3.3.10 Movement Joints: Provide control joints in interior and/or exterior masonry walls as indicated on Drawings and/or as directed at following general locations:

.1 Where wall height changes; where wall direction changes; where wall thickness changes; at pipe and column chases; at bond beam breaks; at abutments of columns

and walls; at abutment of cold garages to warm basements or walls; at openings in walls such as doors and windows; and at intervals in continuous walls as follows:

.1 Up to: 2400 mm high 9000 to 10500 mm oc
.2 2400 mm to 3600 mm 10500 to 12000 mm oc
.3 Over: 3600 mm high 12000 to 13500 mm oc

3.3.11 Expansion Joints: Provide expansion joints within wall construction in locations indicated on Drawings.

3.4 Field Quality Control

3.4.1 Site Tests, Inspection: in accordance with Section 04050 – Masonry Procedure.

3.4.2 Manufacturer's Field Services: in accordance with Section 04050 – Masonry Procedure.

3.5 Protection

3.5.1 Brace and protect concrete unit masonry in accordance with Section 04050 - Masonry Procedure.

3.6 Cleaning

3.6.1 Clean in accordance with Section 01740 Cleaning, and 04050 Masonry Procedures, supplemented as follows.

.1 Standard Concrete Unit Masonry:

.1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block.
.2 Clean wall surface with suitable brush or burlap.

.2 Rub smooth all ridges and protrusions on block faces. Rub smooth forming ridges at bullnose blocks.

.3 Rub smooth all ridges and sharp edges where existing masonry has been sawn cut for new openings.

.4 Clean exposed masonry to satisfaction of Engineer after mortar has hardened.

.5 Where new block is stained or soiled, clean in accordance with manufacturer’s instructions.

3.7 Repair/Restoration

3.7.1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

END OF SECTION

DIVISION 5 – METALS

Section No.	Title
05120	Structural Steel
05500	Metal Fabrications
05510	Metal Stairs and Ladders
05550	Anchorage in Concrete and Masonry

1 GENERAL

1.1 Scope of work

1.1.1 Work supplied under this section includes the supply and installation of structural steel as indicated on the contract drawings.

1.1.2 Design, supply and install all connections for the work of this Section.

1.1.3 Refer to section 05500 Matel Fabrications for other miscellaneous metal items, which are not included in this section.

1.2 Related Sections

1.2.1 Section 03300 – Cast-in-Place Concrete

1.2.2 Section 04050 – Masonry Procedures

1.2.3 Section 05500 – Metal Fabrications

1.2.4 Section 05510 – Matel Stairs and Ladders

1.2.5 Section 07840 – Fire Stopping

1.2.6 Section 09900 – Painting

1.3 Reference Standards

1.3.1 The “Code of Standard Practice for Structural Steel for Buildings” of the CISC shall govern this work, except as otherwise noted on drawings or in specification.

1.3.2 National Building Code of Canada (NBCC)

1.3.3 Canadian Standards Association (CSA):

.1 CAN/CSA S16-19 – Design of Steel Structures

.2 CSA W178.1-18 – Certification of Welding Inspection Organizations

.3 CSA W59-18 - Welded Steel Construction (Metal-Arc Welding)

.4 CSA W47.1-19 - Certification of Companies for Fusion Welding of Steel Structures

.5 CAN/CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

.6 CSA G189-1966 (R2003) – Sprayed Metal Coatings for Atmospheric Corrosion Protection

.7 CAN/CGSB-1.171-98, Inorganic Zinc Coating

.8 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating

1.3.4 Canadian Institution of Steel Construction (CISC):

.1 CISC/CPMA Standard 1-73a - A Quick-drying One-coat Paint for Use on Structural Steel

.2 CISC/CPMA Standard 2-75 - A Quick-drying Primer for Use on Structural Steel

1.3.5 American Society for Testing and Materials (ASTM):

.1 ASTM A108-18, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

.2 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.3 ASTM A653/A653M-20 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.4 ASTM F3125/F3125M-19e2 - Standard Specification for Structural Bolts, Steel, Head Treated, 120/105 ksi Minimum Tensile Strength

.5 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength

.6 ASTM A780/A780M-20 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

.7 ASTM A992 / A992M - 20 Standard Specification for Structural Steel Shapes

.8 ASTM F1554-18, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

9 ASTM B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

10 ASTM F436, Standard Specification for Hardened Steel Washers.

11 ASTM F959, Standard Specification for Compressible Washer Type Direct Tension Indicators for Use with Structural Fasteners

1.3.6 Society of Protective Coatings (SSPC):

.1 SSPC-SP 4 – Power Tool Cleaning

.2 SSPC-SP 6/NACE No. 3 – Commercial Blast Cleaning

.3 SSPC-SP 7/NACE No. 4 - Brush-off Blast Cleaning.

1.3.7 American Welding Society (AWS): D1.1, Structural Welding Code Steel

1.4 Design Requirements

1.4.1 Design details and connections to resist forces, moments and shears indicated. Use standard connections as per CISC Handbook where possible.

1.4.2 Retain a Professional Engineer to be responsible for the design of connections not specifically designed and detailed by the Consultant.

1.4.3 For non-standard connections, submit sketches and design calculations.

1.4.4 Use shop welded and field bolted connections unless otherwise shown on the Drawings.

1.4.5 Use end plate (shop welded) or double angle header connections (shop bolted or welded) for all simply supported beam connections. Provide moment connections where shown on the Drawings.

1.4.6 Use connection angles and end plates with lengths of not less than one half of the depth of the connected member.

1.4.7 All connections shall be designed and detailed to resist connection forces provided on the Structural Drawings.

1.4.8 Where forces are not provided; design connections for all simply supported non-composite flexural members (beams, channels, etc.) at each end for the support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam. For composite beams, increase connection load at each end to 75 % of the total uniformly distributed factored load on the steel section only.

1.4.9 Design connections for eccentricities where shown on the structural design drawings. In all cases the minimum eccentricity to be 10% of the member.

1.4.10 Provide reinforcement of unconnected sides of HSS members, where detailed and shown on the structural design drawings.

1.4.11 Use bearing type bolted connections except the following:

.1 Use slip critical Class A bolted connections for vertical bracing systems, column splices, crane runway beams and where shown on the Drawings.

.2 Use not less than the equivalent of two bolts in each connection.

1.4.12 Welds are to be seal welded, no stitch welding is permitted.

1.4.13 Cutting of holes in any structural steel member in the field is not permitted without the written approval of the Consultant.

1.5 Vertical and Horizontal Bracings

1.5.1 Connect all tension and compression members for the axial force shown on the Drawings plus the shear force due to direct member loading, if applicable. Ensure that the total capacity of the connection is not less than 50 percent of the factored resistance of the member based on the behaviour of the member in the overall structure, and on its gross cross sectional area. Ensure that connections for earthquake forces satisfy applicable code requirements.

1.5.2 In designing the connections apply the load combination factors given in the National Building Code of Canada, subsection 4.1.3 Limit States Design.

1.6 Splicing

1.6.1 Structural steel members shall not be spliced unless approved by the Consultant in writing.

1.6.2 Do not make splices in vertical and horizontal members unless necessary to accommodate shipping lengths. Do not commence with splicing until proposed methods shown on shop drawings have been reviewed by the Engineer.

1.6.3 After the Engineer's review, ensure that splice connections develop full design capacity of spliced structural members unless otherwise indicated on the drawings.

1.7 Quality Assurance

1.7.1 Execute work of this section only by a structural steel fabricator who is fully accredited and a current member of the Canadian Institute of Steel Construction, or who has demonstrated similar experience of no less than five (5) projects successfully completed of similar type, magnitude and complexity. Contractor shall submit these experience requirements for review and approval.

1.7.2 Welding shall meet specified requirements of CAN/CSA S16 and CSA W59 as applicable and shall be performed only by a fabricator fully certified to the conditions of CSA Qualification Code W47.1. Conform to CAN/CSA S16 where requirements are at variance.

1.7.3 Engage a Professional Engineer, licensed to practice in the province of Ontario, to design and /or review all connections related to structural steelwork. When requested by the Consultant, submit calculations signed and sealed by the Engineer responsible for the connections.

1.7.4 Submit a certified copy of Mill Test Certificates or provide an affidavit (based on material testing) stating that the materials and products that have been used in fabrication conform to the applicable material or product standards and are new materials.

1.7.5 General Review by the Consultant is undertaken so that the Owner may be informed as to the quality of the Contractor’s performance and for the protection of the Owner. This does not relieve the fabricator of their responsibility for the performance of the Contract and they shall implement their own supervisory and quality control procedures.

1.8 Submittals

1.8.1 Complete submittals in accordance with Specification Section 01330.

1.8.2 Submit Contractor experience record as per clause 1.7.1

1.8.3 Submit welders certification.

1.8.4 Submit Mill certificates as per clause 1.7.4.

1.8.5 Submit erection drawings in accordance with CAN/CSA S16.

1.8.6 Erection drawings shall include:

.1 Reference to the design drawings, building and room location.

.2 The size, spacing and location of structural steel members, connections, attachments, reinforcing and anchorage.

.3 The necessary plans, elevations and details.

.4 The size and type of fastening, and for weld connections use welding symbols in accordance with Appendix D of CSA Standard W59 and clearly indicate net weld lengths.

.5 Typical connection details

.6 Special connection details including moment connections

.7 Information for setting items of structural steel to be built or drilled into the work of other Sections.

.8 Orientation of bearing plates and size of anchor bolt holes.

.9 Holes and copes for connections and clearance for the work of other trades

.10 All details of field welding

.11 Modifications to existing steel with sufficient details to clarify the work required.

.12 All material specifications indicating steel grades, and finishes.

.13 All drawings shall be certified by a professional engineer.

.14 If requested, submit shop fabrication drawings to the Consultant for information. The shop drawings should Indicate fabrication details including cuts, copes, connections, bolt tension, holes, bearing plates, threaded fasteners, shop coatings, galvanizing, or other surface treatments, and welds on shop details. Indicate welds using American Welding Society (AWS) welding symbols in accordance with ANSI/AWS A2.4.

2 PRODUCTS

2.1 Materials

2.1.1 Materials to be new, unless specified otherwise, free from defects impairing strength and durability (not weathered or rusted) in accordance with reference standards and quality as listed below and as shown on the structural drawings.

.1 All structural metals: New stock (not weathered or rusted)

.2 “W” shapes: conform to CAN/CSA G40.21, Grade 350W, ASTM A572 or ASTM A992, Grade 50

.3 Welded wide flange (WWF): conform to CSA G40.20/G40.21, Grade 350W

.4 Hollow Structural Sections (HSS): conform to CAN/CSA G40.21, Grade 350W, Class C or ASTM A500, unless noted otherwise.

.5 Plates, angles and channels: conform to CAN/CSA G40.21, Grade 300W.

.6 Structural Pipe: ASTM A53, Grade B

.7 Cold Formed Sections (coated): conform to ASTM A653M, Grade 345W or approved equivalent.

.8 Arc welding electrodes and equipment: conform to CSA W48 Electrode Classification Series 490 MPa low hydrogen type dry welding electrodes

.9 High strength bolts and nuts: conform to ASTM F3125. Unless noted otherwise, use bearing-type connections with snug-tightened bolts

.10 Machine bolts: conform to ASTM A307

.11 Anchor Rods: conform to ASTM F1554 Grade [36] [55] [105].

.12 Shear Stud Connectors: ASTM A108

.13 Hot-dip Galvanizing: To meet requirements of ASTM A123MPaint:

.1 Shop Coat: To meet requirements of CISC/CPMA Standard 1-73a, a quick drying paint for use on Structural Steel. (Lead based paints not permitted)

.2 Prime Paint: To meet specified requirements of CISC/CPMA Standard 2-75, a quick drying paint for use on Structural Steel. (Lead based paints not permitted)

.3 Zinc-rich primer and touch-up paint:

.1 Inorganic: Conform to CAN/CGSB-1-GP171

.2 Organic, ready mixed: Conform to CAN/CGSB-1.181

.4 Cleaning: Blast clean all steel in accordance with SSPC-SP7.

2.2 Substitutions

2.2.1 Proposals for substitutions of different steel members for those indicated on drawings will be entertained by the Consultant should availability, scheduling, shop practices or similar reason merit their consideration.

2.2.2 Submit proposals for substitutions to the Consultant with reasons for their proposal and with all supporting design calculations required as evidence that the structure will not be compromised.

2.2.3 Do not proceed with work incorporating substitutions without their approval by the Consultant.

2.3 Fabrication

2.3.1 Conform work to CAN/CSA S16 and CSA W59.

2.3.2 Work of this section shall provide a complete steel structure as indicated on structural drawings and incorporated into other constructions as shown on all other contract drawings

and as specified herein. It shall include all components required for total structural integrity, coordinated with the work of other sections.

2.3.3 Clearly mark pieces by stamping or painting to prevent obliteration during shipping and handling for identification of individual pieces, in accordance with identification schedules on the shop drawings, to clearly indicate the location of each piece in the Work for installation.

2.3.4 Prepare steel work for attachment of other work, including, but not restricted to, bolt holes, anchor holes, anchor rods or brackets, slips and similar attachments. Prior to cutting and/or cope members to provide clearances for adjacent work incorporated in construction and to retain lines of finishes, obtain approval from the Consultant. Locate required preparation and cutting for members as directed by those responsible for other work.

2.3.5 Shop welding shall conform to welding requirements as specified in CSA W59.

2.3.6 Do not fabricate steel members until erection diagrams have been returned. Any work done prior to return of erection diagrams will be at the fabricator's risk or at the contractor's written request and risk.

2.3.7 The minimum size of welds shall be as required in CSA W59: For cold-rolled steel a minimum of 3 mm (1/8"); for hot-rolled steel, a minimum of 5 mm (3/16") unless a larger size is required by CSA W59.

2.3.8 Complete welded shop connections prior to galvanizing when possible.

2.3.9 All welds to be seal weld only.

2.3.10 Provide structural work bearing on concrete or masonry with base or bearing plates, as indicated on the drawings.

2.3.11 Cut required holes in steel members and reinforce openings only to details on drawings, or as approved by Consultant.

2.3.12 Provide adjustable steel anchors 63 mm x 6 mm on columns that abut masonry for anchoring at 800 mm centres.

2.3.13 Shop and field connections shall be welded or bolted with high tensile bolts.

2.3.14 Orientate straight beams which have cambers within allowable mill tolerances so that the resulting camber is up.

2.3.15 Do not splice steel members unless required and approved by the Consultant.

2.3.16 For Hollow Steel Sections:

.1 Provide 19 mm (3/4") diameter weep holes to prevent water accumulation at low spots.

.2 All open ends are to be capped with 6 mm (1/4") plate, fully welded and ground smooth.

2.3.17 When shop inspection is required, the General Contractor is to coordinate inspection of material before it is shipped to the site.

2.3.18 Painting:

.1 All steel work shall receive one shop coat of paint. Clean and prepare surfaces to meet requirements of CISC/CPMA Standard 1-73a, A Quick-dry One-coat Paint for Use on Structural Steel.

.2 Paint steel members under cover in shop and keep them under cover until paint has dried.

.3 Prepare paint material in accordance with paint manufacturer's published instructions. Comply with paint manufacturer's recommendations relative to equipment and application techniques.

.4 Give surfaces to receive finish top coats or paint, one (1) coat of prime paint to a dry film thickness of 1.5 to 2.5 mils.

.5 For shop coat and field touch-up: Clean and prepare surfaces in accordance with CISC/CPMA Standard 1-73a.

.6 Use power tool cleaning to SSPC-SP3 unless otherwise specified on steel exposed to view.

.7 Remove paint for at least 50 mm beyond surfaces that are welded after painting.

.8 Do not paint:

.1 Contact surface of slip-critical connections;

.2 Portions of surfaces that are to receive field welds;

.3 Portions of steel members, to be encased in or in contact with cast in place concrete;

.4 Members that are to be galvanized;

2.3.19 Galvanizing

.1 When specified on structural design drawings, fabricated members shall be zinc 'hot-dip' galvanized after fabrication in accordance with all pertinent ASTM standards and primarily ASTM A123/A123M. The minimum average zinc coating thickness is dictated in Table 1 of the ASTM A123/A123M standard and shall generally meet or exceed 85 microns. Where welding after galvanizing is necessary, the zinc shall be removed by grinding and the damage repaired in accordance with ASTM A780/A780M.

2.3.20 For Architectural Exposed Structural Steel (AESS):

.1 Where finished surfaces of steel are to be left exposed to view, fabricate as specified in Appendix I of CISC Code of Standard Practice as AESS1 for corrosive environments, including special straightness.

.2 Continuously weld connection joints where exposed to view and grind them smooth and flush with adjacent surfaces.

.3 Remove mill marks, identification and surface imperfections by grinding smooth and flush with adjacent surfaces.

.4 Unless otherwise specified, all AESS members shall be cleaned to meet requirements of SSPC-SP 6 for paint surface preparation.

3 EXECUTION

3.1 General

3.1.1 Erect structural steel indicated on the structural design drawings.

3.1.2 Detail connections of steel members so as not to interfere with architectural clearance lines or finishes that are shown on design drawings.

3.1.3 Do not field cut members without the Consultant's prior approval.

3.1.4 Temporary bracing shall be in accordance with CSA S16 or this specification. Bracing members shown on structural design drawings are not to be assumed adequate for erection purposes.

3.1.5 Framing around openings. Provide structural steel members, where shown, at perimeter of openings through metal decking. Member sizes are as shown on the structural design drawings.

3.1.6 Web stiffeners where required by connection design or as shown on structural design drawings.

3.2 Examination

3.2.1 Before delivery of materials to site, verify the position of anchor rods and surfaces and conditions upon which work of this section depends. Any deviations found from structural or architectural drawings are to be submitted to the Consultants for their written instructions. Commencement of erection shall imply acceptance of other work.

3.2.2 Where new steel connects to existing steel, check that the information and dimensions shown on the drawings, are correct, by field measuring the existing steel, as necessary.

3.2.3 Report all defects and discrepancies. Do not deliver to the site materials which are known not to meet the requirements of the Specifications. If rejected after delivery, remove immediately from site.

3.3 Preparation

3.3.1 Supply base and bearing plates, anchor rods and other built-in work to those responsible for its inclusion with their work. Deliver built-in items before they are required to place designated by Contractor. Supply necessary information for proper incorporation of built-in work and otherwise cooperate with installers.

3.4 Product, Delivery, Storage and Handling

3.4.1 Delivery of Materials:

.1 Maintain cleanliness of steel until it is delivered onto the site.

3.4.2 Handling:

.1 Protect architecturally exposed steel during fabrication, handling, shipping, storage and erection to prevent damage to surfaces by marking, bending, denting and soiling with grease, oil, weld flux and other foreign materials.

.2 Steel shall be stored on site for as short a time as possible and shall be stored in such a manner as to prevent twisting, bending or warping, or other structural damage of individual steel members of preassembled components. Ensure members do not acquire permanent camber or deflection. Mark members and tags used to correlate with the erection drawings – must be visible and are not to be removed until the steel is erected and inspected.

.3 Primed or painted steel shall be stored such that the finish is not damaged. In winter months, steel must be covered to prevent ice build-up and to prevent water from entering hollow sections.

.4 Store fastener components according to CSA S16.

3.5 Erection

3.5.1 Erect the work of this section in accordance with CAN/CSA S16.

3.5.2 Brace and support structure during erection to ensure that it is maintained in alignment under construction and other loading and until all other construction elements contributing to stability are in place. Failure to make adequate provision for erection stresses shall be the sole responsibility of the contractor.

3.5.3 Provide hardened washers under the turned element of all high strength bolts.

3.5.4 Do not cut holes in the field unless sizes and locations are accepted by the Consultant in each case. Accepted field cutting and welding shall be undertaken by this section.

3.5.5 All high-strength bolts are to be installed to a snug tight condition except as noted in Clause 1.3.12.

3.5.6 Erect individual members of the structural steel to the tolerances given in CSA S16.

3.5.7 Set column base plates on leveling plates which are to be set with grout at the required elevation by others and are to be level to within 1.5 mm (1/16”) across the plate. Leveling plates are to be used under base plates when base plates are less than 0.26 square meters (400 square inches) in area. Set column base plates on leveling nuts / shims to the required elevation ready for grouting when base plate area exceeds the above.

3.5.8 Do not make permanent connections until as much of the structure as will be stiffened thereby has been suitably aligned.

3.5.9 Report ill-fitting connections to the Consultant before taking corrective measures.

3.5.10 Remove paint from surfaces that are to receive primary welds. Secondary weld surfaces i.e. joist shoes or bridging need not have the paint removed.

3.5.11 Do not weld in an ambient temperature below -10°C (14°F). Preheat according to CSA W59 requirements.

3.5.12 Remove slag from all completed welds so that they may be visually inspected.

3.5.13 After erection, touch up paint with one (1) coat CISC/CPMA 1-73a one-coat paint to match shop coat to field connections, bolt heads and nuts, primary welds and major abrasions and burnt surfaces. Bolt assemblies and bridging welds do not require touch up.

3.5.14 All welds on galvanized members, and where galvanizing has been damaged during erection and handling, are to be touched up with zinc rich paint

3.6 Field Quality Control

3.6.1 A qualified independent inspection and testing company may be engaged by the Owner for this work.

3.6.2 The inspection shall cover shop work and field erection work to review for compliance with the CSA S16. Inspectors will randomly review materials to ensure conformance to the requirements of this specification.

3.6.3 The inspection agency will submit reports to the Consultants, Contractor, Steel Fabricator and Municipal Authorities covering the Work inspected and provide details of nonconformities or deficiencies observed.

3.6.4 Notify the Engineer two weeks in advance of the date when the first work will be ready for inspection.

3.6.5 Contractor to provide adequate access to allow for inspections to be performed.

3.6.6 The scope of inspection may include:

.1 Shop inspection of fabrication in the plant.

.2 Mill test reports (fabricator's affidavit will be accepted).

.3 Company certification is in accordance with CSA W47.1 Division 1 or 2.

.4 Welders' CWB Qualifications.

.5 Welding procedures are approved by the CWB in accordance with to CSA W47.1 and CSA W59.

.6 Splicing details and procedures.

.7 Overall dimensions.

.8 Fabricated members against specified member sections.

.9 Cambers and sweeps.

.10 Workmanship regarding layout, punching and drilling of holes.

.11 Shop and field inspection of bolt installation.

.12 Shop and field inspection of welded joints.

.13 General inspection of field cutting and alterations.

.14 General inspection of surface preparation, shop painting and field touch-up for structural steel.

.15 Review location of anchor rods and other embedded items. Tolerances for anchor rods location to be in accordance with CSA S16 and CISC Code of Standard Practice for Structural Steel – Item 7.7.

.16 Sample checking that tolerances are not exceeded during erection including fit-up of field welded joints.

.17 Installation of sliding bearings

.18 Galvanizing and field touch-up

.19 Grouting under base plates and bearing plates

.20 Sample checking of stud anchors

.21 Sample checking of drilled concrete and masonry anchors.

3.6.7 The inspector shall carry out visual inspection of at least 10% of all connections and 100% of butt joints that are loaded in direct tension.

3.6.8 Structural steel items to be cast into concrete / masonry shall be randomly inspected prior to concrete / grout placement.

3.6.9 The Inspection Organization to start field inspection as soon as each section of the work has commenced in the field.

3.6.10 In so far as possible, the fabricator and erector shall cooperate with the inspector, permitting access for inspection to all places where work is being done. The inspector shall cooperate in avoiding undue delay in the fabrication or erection of the steelwork.

3.6.11 The cost of independent inspection will be paid by the owner.

3.6.12 Installation of bolts shall conform to the requirements of CSA S16. Bolts to be snug tight unless as noted in Clause 1.3.11. The use of a torque wrench for random bolt inspection shall not be permitted unless otherwise approved by the Consultant and communicated to the Erector prior to erection. Any use of a torque wrench for inspection shall meet the requirements of CSA S16.

3.6.13 The inspector shall, as a minimum, visually examine all welded joints for inclusions, porosity, lack of fusion, penetration, contour, under-cuts and cracks.

3.6.14 Remove and replace non-conforming materials without delay and without extra cost.

3.6.15 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.

3.7 Field Painting

3.7.1 Touch-up all damaged surfaces and surfaces without shop coat with CISC/CPMA 2-75, in accordance with manufacturer's recommendations.

3.7.2 Paint in accordance with Section 09900 – Painting.

3.8 Misfits Bolted Connections

3.8.1 Where misfits in erection bolting are encountered, immediately notify the Consultant for approval of one of the following methods of correction:

.1 Ream holes that must be enlarged to admit bolts and use oversized bolts.

.2 Plug weld misaligned holes and re-drill holes to admit standard size bolts.

.3 Drill additional holes in connection, conforming with CSA Standards for bolt spacing and end and edge distances, and add additional bolts.

.4 Reject member containing misfit, incorrect sized, or misaligned holes and fabricate new member to ensure proper fit.

3.8.2 Do not enlarge incorrectly sized or misaligned holes in members by burning or by use of drift pins.

3.9 Misfits Anchor Bolts

3.9.1 Resolve misalignments between anchor bolts and bolt holes in steel members in accordance with approved submittal.

3.9.2 Do not flame cut to enlarge holes without prior approval of the Consultant.

END OF SECTION

1 GENERAL

1.1 Scope of Work

1.1.1 Design, supply and install the following items including bolts, nuts, washers, anchors, hardware,

.1 Lintels, concrete protection angles, embedded grating supports

.2 Checkered plate covers and supports

.3 Fall protection davit bases and davit mast.

.4 All other miscellaneous metal items shown on the drawings.

1.2 Related Sections

1.2.1 Section 01330 - Submittals

1.2.2 Section 03300 - Cast-in-Place Concrete

1.2.3 Section 04050 - Masonry Procedures

1.2.4 Section 04052 - Masonry Anchorage and Reinforcing

1.2.5 Section 05120 - Structural Steel

1.2.6 Section 05510 - Metal Stairs and LaddersSection 09900 – Painting

1.2.7 Section 11190 – Pipe and Valve Supports

1.3 References

1.3.1 All products shall conform to the following standards and regulations:

1.3.2 ASTM International (ASTM).

.1 ASTM A53/A53-20 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

.2 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.3 ASTM A276/A276M-17 - Standard Specification for Stainless Steel Bars and Shapes

.4 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength

.5 ASTM A780/A780M-20 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

.6 ASTM D1187/D1187M-20 - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal

.7 ASTM D5360-15 – Standard Practice for Design and Construction of Bituminous Surface Treatment

.8 ASTM D6511/D6511M-18 - Standard Test Methods for Solvent Bearing Bituminous Compounds

.9 ASTM F1554-20 – Standard Specifications for Anchor Bolts

.10 ASTM F3125-15 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 830 MPa and 1040 MPa Minimum Tensile Strength

.11 ASTM F593-17 – Standard Specification for Stainless Steel bolts, Hex Cap Screws, and Studs.

1.3.3 Canadian Standards Association (CSA):

.1 CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

.2 CAN/CSA S16-19 - Design of Steel Structures

.3 CAN/CSA S157-17/S157.1-17 - Strength Design in Aluminum / Commentary on CSA S157-05, Strength Design in Aluminum

.4 CSA W47.2-11 (R2020) – Certification of Companies for Fusion Welding of Aluminum

.5 CSA W48-18 - Filler Metals and Allied Materials for Metal-Arc Welding

.6 CSA W59.2-M1991 (R2018) - Welded Aluminum Construction

.7 CSA W59-18 - Welded Steel Construction (Metal-Arc Welding)

1.3.4 American Institute of Steel Construction (AISC):

.1 AISC 370-21 Specifications for Structural Stainless Steel Buildings

1.3.5 American Welding Society (AWS)

.1 AWS D1.6/D1.6M-17 – Structural Welding Code – Stainless Steel

1.3.6 The National Association of Architectural Metal Manufactures (NAAMM):

.1 NAAMM-AMP 521-01(R2012) – Pipe Railing System Manual (Fourth Edition)

1.4 Shop Drawings

1.4.1 Submit shop drawings in accordance with Section 01330 – Submittals.

1.4.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

1.4.3 Design loads and general arrangement shall be clearly identified on the shop drawings.

1.4.4 In preparing shop drawings, the fabricator shall verify that all component parts and assembly of each item will support the superimposed loads without deflection detrimental to function, appearance or safety.

1.4.5 Provide signed and sealed shop drawings certified by a Professional Engineer licensed in the Province of Ontario.

1.4.6 Upon request, submit design calculations signed and sealed by a Professional Engineer licensed in the Province of Ontario.

1.5 Protection

1.5.1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.

1.5.2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

1.5.3 Prevent metals from collecting standing water and protect from staining.

2 PRODUCTS

2.1 Materials

2.1.1 Structural steel columns and beams: to CSA G40.20/G40.21, Grade 350W.

2.1.2 Steel angles, channels and plates: to CSA G40.20/G40.21, Grade 300W.

2.1.3 Hollow Structural Sections (HSS): conform to CAN/CSA G40.21, Grade 350W, Class H.

2.1.4 Welding materials:

.1 to CSA W59 for Steel.

.2 to CSA W59.2 for Aluminum.

.3 to AWS D1.6 for Stainless Steel

2.1.5 Welding electrodes: to CSA W48 Series.

2.1.1 Anchor Rods: to ASTM F1554.

2.1.2 High Strength Bolts and Nuts: to ASTM F3125

2.1.3 Aluminum shall conform to the following alloy designations of the Aluminum Association:

.1 Extruded Shapes – Structural: 6061-T6.

.2 Smooth Plates: 5083-H34.

.3 Rivets and Bolts: 6061-T6.

.4 Checkered or Tread Plate: 6061-T6.

2.1.4 Stainless steel shapes: to ASTM A276, Type 316L

2.1.5 Stainless steel plate: Type 316L…….

2.1.6 Stainless steel bolts and nuts: to ASTM F593, Type 316L

2.1.7 Grout: non-shrink, non-metallic, flowable, 24h, 15 MPa at 24 hours, pull-out strength 7.9 MPa.

2.2 Fabrication

2.2.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

2.2.2 Use self-tapping shake-proof screws on items requiring assembly by screws or as indicated.

2.2.3 Where possible, fit and shop assemble work, ready for erection.

2.2.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 Finishes

2.3.1 Galvanizing: hot-dipped galvanizing with zinc coating 610 g/m^2 to ASTM A123M.

2.3.2 Zinc primer: zinc rich, ready mix in accordance with Section 09900 Paint.

2.3.3 Bituminous Paint: quick-drying asphalt utility enamel.

2.3.4 Aluminium to be anodized.

2.4 Isolation Coating

2.4.1 Isolate aluminum from following components, by means of bituminous paint:

.1 Dissimilar metals except stainless steel, zinc or white bronze of small area.

.2 Concrete, mortar and masonry.

.3 Wood.

~~2.5 Shop Painting~~

2.5.1 Apply one (1) coat of primer to metal items, with exception of galvanized or concrete encased items.

2.5.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7ºC.

2.5.3 Clean surfaces to be field welded. Do not paint.

2.6 Checkered Plates and Frames

2.6.1 Plates shall be provided with welded ribs as required to limit deflection of any plate to 1/240th of the span under a concentrated load of 1.0 kN at the centre or 4.8 kPa uniform live loading unless noted otherwise.

2.6.2 All free edges of the panel are to be stiffened to limit deflection and tripping hazard between adjacent plates.

2.6.3 All checkered plates shall be approved 'raised' patterns and the edges of all plates shall be planed to a straight edge. The minimum thickness of plates shall be 6 mm.

2.6.4 Checkered plates, when not detailed, shall be designed, subdivided and fastened as to be readily removable. Where cut, abutting edges shall have continuity of pattern.

2.6.5 The angle frames and border bars shall have mitred corners neatly fitted and welded. Border bars shall be fastened to angle frames by welding.

2.6.6 Checkered plates shall be fabricated in panels that can be easily handled by plant personnel. Unless otherwise indicated on the drawings, the weight of individual panels shall not exceed 35 kg.

2.6.7 Panels shall be within 6 mm of authorized length and 6 mm of authorized width, and shall have a maximum difference in length of opposite diagonals of 6 mm.

2.6.8 After installation, there shall be not more than 6 mm clearance between panels. Provide minimum of four recessed handles per panel. Handles to be max 300mm from edge of panel. Provide openings in checkered plate as required for process control and instrumentation penetrations. Contractor to provide checkered plate designer with approved channel aeration and odour control piping shop drawings prior to submitting checkered plate shop drawings. All dimensions must be field verified prior to fabrication.**Pipe "Grab" Bars**

2.7.1 Stainless steel or aluminum pipe: 50 mm nominal outside diameter, formed to shapes and sizes as indicated on drawings.

2.7.2 m.

2.8 Slab Corner Guards

2.8.1 Cast-in Stainless steel angles complete with welded studs as indicated on drawings.

2.9 Embedded Support Frames for Floor Plate, Precast Stair Landing and Grating

2.9.1 Embedded angle support frames which are to be embedded in concrete shall be stainless steel, A276, AISI Type 316, unless indicated otherwise in the Contract Documents.

2.10 Miscellaneous Lintel Angles

2.10.1 Miscellaneous lintel angles as indicated on the design drawings. Galvanized for face masonry supports.

2.10.2 Where lintel or shelf angle size is not shown, design lintels to NBC 9.20.5.2 Lintels or Arches.

2.10.3 Provide adjustable lintel anchors where indicated and detailed.

2.11 Pipe Supports

2.11.1 Supply pipe supports as described in section 11190 Pipe Supports.

2.11.2 All pipe supports shall be Type 304 or 316 stainless steel

2.12 Miscellaneous Items

2.12.1 Review all drawings and include all other metal fabrication not included in the above noted list.

3 EXECUTION

3.1 Erection

3.1.1 Do welding work in accordance with CSA W59, unless specified otherwise.

3.1.2 Erect metal work square, plumb, straight and true, accurately fitted with tight joints and intersections.

3.1.3 Provide suitable means of anchorage acceptable to engineer such as dowels, anchor clips, bar anchors, expansion bolts and shields, chemically anchored bolts and toggles.

3.1.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

3.1.5 Provide components for building by other sections in accordance with shop drawings and schedule.

3.1.6 Make field connections with bolts to CAN/CSA S16 or weld.

3.1.7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

3.1.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

3.1.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

END OF SECTION

1 GENERAL

1.1 Scope of Work

1.1.1 Fabricate and install metal stair and ladder assemblies in accordance with the requirements set forth in this section.

1.2 Related Sections

1.2.1 Section 01330 – Submittals

1.2.2 Section 03300 – Cast-in-Place Concrete

1.2.3 Section 04050 – Masonry Procedures

1.2.4 Section 05120 – Structural Steel

1.2.5 Section 05500 – Metal Fabrications

1.2.6 Section 09900 - Painting

1.3 Reference Standards

1.3.1 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A276/A276M-17 - Standard Specification for Stainless Steel Bars and Shapes

.3 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength

.4 ASTM A53/A53M-20 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

.5 ASTM F1554-20 - Standard Specifications for Anchor Bolts

.6 ASTM F3125-15 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 830 MPa and 1040 MPa Minimum Tensile Strength

1.3.2 The National Association of Architectural Metal Manufactures (NAAMM):

.1 NAAMM AMP 510-92 - Metal Stair Manual (Fifth Edition)

1.3.3 American National Standards Institute (ANSI):

.1 ANSI/NAAMM AMP 521-01 (R2012) – Pipe Railing Systems Manual (Fourth Edition)

.2 ANSI/NAAMM MBG 531-17 - Metal Bar Grating Manual

1.3.4 Canadian Standards Association (CSA):

.1 CSA G40.20-13/G40.21-13 (R2018)- General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

.2 CSA S16-19 - Design of Steel Structures

.3 CAN/CSA S157-17/S157.1-17 - Strength Design in Aluminum / Commentary on CSA S157-05, Strength Design in Aluminum

.4 CSA W59-18 - Welded Steel Construction (Metal-Arc Welding)

.5 CSA W59.2-M1991 (R2018) - Welded Aluminum Construction

1.3.5 Ontario Building Code (OBC)

1.4 Quality Assurance

1.4.1 In addition to the requirements of 01450 – Quality Control, the following measures are required:

1.4.2 Fabricator Qualifications

.1 Work of this section shall be carried out by a fabricator specialized in the type of work specified herein.

.2 Fabricator must have been producing stair systems for at least ten (10) years.

1.4.3 Installer Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by fabricator for application of materials being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

1.5 Submittals

1.5.1 Complete submittals in accordance with Specification Section 01330.

1.5.2 Shop Drawings

.1 Submit engineered and certified shop drawings in accordance with Section 01330 – Submittals.

.2 Indicate construction details, sizes of aluminum and/or steel sections and thickness of aluminum and/or steel sheets.

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.4 Comply with NAAMM minimum standards for construction, proportions and dimensions of fixed metal stairs.

.5

.6 Show all field connections.

.7 Provide setting diagrams for installation of anchors, location of pockets, weld plates for attachment of ladder to structure, and blocking for attachment of wall rail.

.8 .

.9 Indicate all required field measurements.

.10 Indicate all design loadings.

.11 Provide shop drawings certified by a Professional engineer licensed in the Province of Ontario.

1.5.3 Delivery Storage and Handling

.1 Refer to Specification Section 01610 - Basic Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.

.4 Storage On Site

.1 Store material in a location and in a manner to avoid damage. Stacking shall be done in a way, which will prevent bending and damage to factory finishes.
.2 Store aluminum, steel and stainless steel components and materials in clean, dry location, away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin or polyethylene sheeting in a manner that will permit circulation of air inside the covering.
.3 Keep handling on-site to a minimum. Exercise particular care to avoid damage to finishes of materials.
.4 Replace defective or damaged materials with new.

2 PRODUCTS

2.1 Design Requirements

.1 Sta

2.1.2 Detail and Design ladders and anchorage in accordance with Ontario Building Code MMAH Supplementary Standard SB-8 requirements.

.1 Factor of safety for designing components with fall arrest systems – 10:1

.2 Factor of safety for designing components for normal use – 4:1

2.2 Materials

2.2.1 Steel sections: to CSA G40.21, Grade 350W.

2.2.2 Steel plate: to CSA G40.21, Grade 300W.

.1 Pattern: Checkered

2.2.3 Anchor Rods: to ASTM F1554.

2.2.4 High Strength Bolts and Nuts: to ASTM F3125

2.2.5 Aluminum shall conform to the following allowable designations of the Aluminum Association:

Extruded Shapes – Structural	6061-T6
Smooth Plates	5083-H34
Rivets and Bolts	6061-T6
Grating	6061-T6
Checkered or Tread Plate	6061-T6
Castings	356-T2
Hand Railing (clear anodized)	6351-T6

2.2.6 All stainless steel to ASTM A276, Type 316.

2.3 Fabrication

2.3.1 Fabricate to NAAMM, Metal Stair Manual.

2.3.2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.

2.3.3 Accurately form connections with exposed faces flush, mitres and joints tight. Make risers of equal height.

2.3.4 Grind or file exposed welds and steel sections smooth.

2.3.5 Shop to fabricate stairs in sections as large and complete as practicable.

2.3.6 Welding:

.1 Accurately miter and cope intersections of posts and rails and weld all around.

.2 Weld joint to match Type 2 as described in page 7 of NAAM AMP 521.

2.3.7 Fabricate joints which will be exposed to the weather so as to exclude water, or provide weep holes where water may accumulate.

2.3.8 If the expected discoloration, due to welding, of anodized aluminum and the resulting color discrepancies are not acceptable, they shall be touched up using an acceptable lacquer.

2.3.9 All welded areas on stainless steel railing systems shall be ground and finished to blend with adjacent areas.

2.4 Ladders

2.4.1 Stainless steel or aluminum ladders and related hardware as shown on the drawings.

2.4.2 Stainless steel or aluminum “grab” bars as shown on the drawings.

2.5 Finishes

2.5.1 Aluminum shall be clear anodized.

2.5.2 Galvanizing: hot-dipped galvanizing with zinc coating 610 g/m2 to ASTM A123M.

2.5.3 Zinc primer: zinc rich, ready mix primer as per section 9900 – Paint.

2.6 Shop Painting

2.6.1 Clean surfaces in accordance with Steel Structures Painting Council SSPC-SP2.

2.6.2 Apply two (2) coats of primer of different colours to parts inaccessible after final assembly.

2.6.3 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale and grease. Do not paint when temperature is below 7ºC.

2.6.4 Do not paint surfaces to be field welded.

3 EXECUTION

3.1.1

3.2 Field touch up

3.2.1 Touch-up abraded areas with same primer paint used for shop priming.

3.3 Cleaning

.1 As installation is completed, was thoroughly using clean water and soap, rinse with clean water.

.2 Do not use acid solution, steel wool or other harsh abrasives.

.3 If stain remains after washing, remove finish and restore in accordance with fabricator's recommendations.

.4 Protective wrappings shall not be removed until items are no longer subject to subsequent construction damage, at which time any necessary cleaning shall be performed.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers the procurement and installation of anchors in concrete and masonry. It includes cast-in-place anchor bolts, post installed anchors which may include adhesive anchors, expansion anchors and epoxy grouted anchor bolts and reinforcing steel to be installed in concrete and masonry.

1.2 Related Sections

1.2.1 Comply with requirements of Division 1.

1.2.2 Section 03300 Cast-In-Place Concrete

1.2.3 Section 04052 Masonry Anchorage and Reinforcing .

1.2.4

1.3 General

1.3.1 Unless otherwise specified or indicated on the drawings, all anchors and anchor bolts shall be cast-in-place anchor bolts with forged heads or embedded nuts and washers. Unless otherwise indicated, bolts in concrete shall have a diameter of at least 20 mm and bolts in grouted masonry shall have a diameter of at least 13 mm.

1.3.2 Unless otherwise indicated on the drawings, anchors and anchor bolts used in the following locations and applications shall be of the indicated materials. Other anchors and anchor bolts shall be as indicated on the drawings. Where stainless steel is indicated, use type 316 stainless steel.

.1 Cast-in-Place Anchor Bolts: Carbon Steel

.2 Submerged locations: Stainless steel

.3 Locations subject to splashing: Stainless steel

.4 Buried locations: Stainless steel

.5 Anchorage of structural steel columns: Galvanized steel

.6 Other exterior locations: Galvanized steel or stainless steel as indicated on the drawings.

.7 Other interior locations: Carbon steel

1.3.3 Threaded Rod and Expansion Anchors:

.1 Submerged locations: Stainless steel, no mechanical anchors permitted

.2 Locations subject to splashing: Stainless steel, no mechanical anchors permitted

.3 Buried locations: Stainless steel

.4 Anchorage of structural steel columns: Stainless steel, no mechanical anchors permitted UNO.

.5 Other exterior locations: Stainless steel, no mechanical anchors permitted

.6 Other interior locations: Carbon steel

.7 Post installation in overhead situation

1.3.4 Adhesive anchors and expansion anchors may be used instead of cast-in-place anchors where with the specific acceptance by the Engineer.

1.4 Submittals

1.4.1 Submit in accordance with Section 01330 – Submittal.

1.4.2 Letters of certification indicating the manufacturer and types of adhesive anchors, expansion anchors and epoxy grouts to be supplied.

1.4.3 A current ICC-ES Evaluation Service Report shall be submitted for all anchors that will be considered for use on this project.

1.4.4 Product Data: Manufacturer's data sheets on each product to be used.

1.4.5 Manufacturer’s Published Installation Instructions (MPII)

1.4.6 Installation Training Records:

.1 Provide a list of names of all installers who are trained by the Manufacturer’s Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information

.2 Provide a copy of the current ACI-CRSI “Adhesive Anchor Installer” certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

1.5 References

1.5.1 Canadian Standards Association (CSA):

.1 CAN/CSA-G30.18-09 (2019) - Carbon Steel Bars for Concrete Reinforcement

1.5.2 American Society for Testing and Materials (ASTM):

.1 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength

.2 ASTM F593-17 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

.3 ASTM F594-09 (2020) - Standard Specification for Stainless Steel Nuts

.4 ASTM A153/A153M-16a - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

.5 ASTM A385/A385M-20 - Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)

1.5.3 American National Standards Institute (ANSI):

.1 ANSI/ASME B18.22M-1981 (R2010) - Metric Plain Washers

1.5.4 American Concrete Institute (ACI):

.1 ACI 355.2-19 – Qualifications of Post-installed Mechanical Anchors in Concrete

.2 ACI 355.4-19 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary

1.5.5 ICC Evaluation Services (ICC-ES):

.1 ICC-ES AC193 – Mechanical Anchors in Concrete Elements

.2 ICC-ES AC308 – Post-Installed Adhesive Anchors in Concrete elements.

.3 ICC-ES ACC446 – Headed Cast-in Specialty Inserts in Concrete

1.6 Delivery, Storage and Handling

1.6.1 Materials shall be handled, transported and delivered in a manner that will prevent damage or corrosion. Damaged materials shall be promptly replaced.

1.6.2 Keep anchors, rod materials, nuts and washers in original manufacturer's packaging with label intact until needed for use.

1.6.3 Keep anchors free of dirt and debris.

1.6.4 Protect anchors from corrosion and deterioration.

1.6.5 Store all anchoring products in strict accordance with manufacturer's recommendations. For adhesive anchors, consider temperature, exposure to sunlight, and shelf life.

1.7 Quality Assurance

1.7.1 All post-installed anchors in concrete shall have current published ICC-ES Evaluation Report indicating the anchor is approved for installation in cracked concrete and shall have seismic qualification to meet the project requirements.

1.7.2 Special inspection, where required by code, shall be in accordance with a current published ICC-ES Evaluation Reports.

1.7.3 Where material or equipment must be supported from the structure, the installer of that material or equipment support shall be responsible for supplying the anchors and meeting the requirements of this specification unless specifically noted otherwise on the Drawings.

2 PRODUCTS

2.1 Materials

2.1.1 Materials shall be as indicated below:

.1 Expansion Anchors: Hilti “Kwik-Bolt”; Red Head “Trubolt Wedge Anchor”; Dewalt “Power-Stud Anchor”.

.2 Reinforcing Bars: CAN/CSA G30.18 grade 400.

.3 Anchor Bolts and Nuts:

.1 Carbon Steel: ASTM A307 or grade 300 rod, with compatible nuts.
.2 Stainless Steel: Bolts, ASTM F593, Alloy Group 2 (316 SS); nuts, ASTM F594, Alloy Group 2.
.3 Galvanized Steel: Carbon steel bolts and nuts; hot-dipped galvanized, ASTM A153/A153M and ASTM A385/A385M.
.4 Flat Washers: ANSI/ASME B18.22M; of same material as anchor bolts and nuts.

.4 Threaded Rod Anchors and Nuts:

.1 Carbon Steel: Grade 300W rod, with compatible nuts.
.2 Stainless Steel: Rods, ASTM F593, Alloy Group 2 (316 SS); nuts, ASTM F594, Alloy Group 2.
.3 Galvanized Steel: Carbon steel rods and nuts; hot-dipped galvanized, ASTM A153/A153M and ASTM A385/A385M.

.5 Adhesive Anchors for Concrete and Grout Filled Masonry:

.1 Threaded Rods and Nuts: As specified for Threaded Rod Anchors and Nuts and as recommended by the adhesive manufacturer.
.2 Adhesive: Hilti “HIT HY 200 v3”, “HIT-ICE”, “HIT RE500”, Dewalt “AC200+”.

.6 Epoxy Grout for Reinforcing Bars, Threaded Rod Anchors and Anchor Bolts:

.1 Adhesive for Floors and Horizontal Surfaces: Sika “Sikadur 35, Hi-Mod LV”; BASF “MasterEmaco ADH 326”; Sika “Sikadur 32 Hi-Mod”, Hilti “HIT RE-500 v3”, Dewalt “Pure220+”.
.2 Adhesive for Vertical Surfaces and Overhead Applications: Sika “Sikadur 31 Hi-Mod Gel”.
.3 Aggregate: As recommended by the epoxy grout manufacturer.
.4 Water: Clean and free from deleterious substances.

.7 Adhesive Anchors for Hollow Masonry System:

.1 Threaded Rod Anchors and Nuts: As specified for Threaded Rod Anchors and Nuts and as recommended by the adhesive manufacturer.
.2 Adhesive: Hilti “HIT HY 270” System; Redhead “Epcon Ceramic 6” System.
.3 Screen Tubes: As recommended by the manufacturer.

2.2 Anchors

2.2.1 Cast-in-Place Anchor Bolts: Cast-in-place anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Anchors bolts shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or the supporting template. Two (2) nuts, a jam nut and a washer shall be furnished for cast-in-place anchor bolts indicated on the drawings to have locknuts; two (2) nuts and a washer

shall be furnished for cast-in-place anchor bolts without locknuts. Installation of anchor bolts is covered in the cast-in-place concrete section.

2.2.2 Adhesive and Expansion Anchors: When adhesive or expansion anchors are indicated on the drawings, only acceptable systems shall be used. Acceptable systems shall include only those systems and products specified or specifically indicated by product name on the drawings. Alternative anchoring systems may be used only when specifically accepted by Engineer. An acceptable adhesive anchor system may be used as an alternative in locations where epoxy grouted anchor bolts and epoxy grouted threaded rod anchors are specified or indicated.

.1 Threaded rod anchors in adhesive anchor systems shall be furnished with a sufficient length to provide an embedment depth of at least 15 rod diameters and free of coatings that would weaken the bond with the adhesive. Unless otherwise required, single nut and washer shall be furnished for threaded rod anchors, adhesive anchors and expansion anchors. Anchor bolts and threaded rod anchors that are to be epoxy grouted shall be clean and free of coatings that would weaken the bond with the epoxy.

.2 Adhesive anchors in hollow masonry shall utilize screen tubes as recommended by the manufacturer.

2.2.3 Epoxy Grouted Anchor Bolts and Reinforcing: Epoxy grout for installing reinforcing steel dowels and anchor bolts not indicated to be adhesive anchors shall consist of a two-component liquid epoxy adhesive of viscosity appropriate to the location and application and an inert aggregate filler component, if recommended by the adhesive manufacturer. Components shall be packaged separately at the factory and mixed immediately before use.

.1 Anchor bolts and reinforcing steel shall be as indicated on the drawings.

.2 Epoxy adhesive for reinforcing bars with deep embedment shall be HIT- RE500 V3 or approved equal.

3 EXECUTION

3.1 General

3.1.1 Anchor bolts shall be installed at the locations indicated on the drawings.

3.1.2 Identify location of embedded items such as reinforcing steel, stressing tendons, conduit, heating tubes, etc. prior to drilling holes by scanning. Coordinate with respective trades if any apparent conflict exists. Exercise care in coring and drilling to avoid damaging any existing embedded items. If embedded items are encountered, stop drilling and contact Engineer immediately for direction. Any offsets or relocations of anchors must be approved by Engineer.

3.1.3 Drill holes of proper diameter and depth in accordance with manufacturer’s published design information for that specific anchor. Use only equipment approved by anchor manufacturer. All holes shall be perpendicular to the concrete surface unless shown otherwise on structural plans and/or details.

3.1.4 Do not drill holes until base material has achieved full design strength.

3.1.5 Installation of all post-installed anchor products shall be conducted in strict accordance with the Manufacturer's Published Installation Instructions (MPII). Use hammer drills for adhesive anchors (unless noted otherwise).

3.1.6 Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchors immediately before final installation and tightening of the nuts.

3.1.7 Anchors shall be located at least 100 mm away from conduits, sleeves and drains bodies at their largest point measured on top of the slab above the anchor, and the like, embedded in the concrete.

3.1.8 Anchors shall be installed in drilled holes with a minimum depth and diameter specified by the manufacturer unless noted otherwise.

3.1.9 Anchors shall be assumed, for determining required anchor size, to be installed in an unreinforced concrete mass.

3.1.10 Clean out holes, properly prepare substrate, and install anchors in accordance with manufacturer's instructions and current ICC-ES ESR. Proper tools must be on job site.

3.1.11 If, when drilling the holes for the anchors, reinforcement is encountered and the hole must be shifted to clear the reinforcement, the abandoned hole shall be patched with non-shrink grout of similar properties as the base concrete.

3.2 Cast-In-Place Anchors and Anchor Bolts

3.2.1 Cast-in-place anchors and anchor bolts shall be carefully positioned with templates and secured in the forms prior to placing concrete. Contractor shall verify that anchorage devices are positioned in accordance with the design drawings and with applicable equipment submittal drawings. Anchors and bolts shall be positioned sufficiently in advance of the concrete placement so that an on-site representative of Engineer or Owner will have sufficient time to inspect the bolts prior to placing concrete. If special inspection of the anchor bolts is required by the local building code, anchorage shall be placed in sufficient time and with sufficient notification so that such inspection can take place without delaying progress of the work.

3.2.2 Threads, bolts and nuts spattered with concrete during placement shall be cleaned prior to final installation of the bolts and nuts.

3.3 Epoxy Grout

3.3.1 Epoxy grout components shall be packaged separately at the factory and shall be mixed immediately before use. Proportioning and mixing of the components shall be done in accordance with the manufacturer's recommendations.

3.3.2 An acceptable adhesive anchoring system may be used where epoxy grouted threaded rod anchors are indicated on the drawings.

3.3.3 Preparation: Where indicated on the drawings, anchor bolts, threaded rod anchors and reinforcing bars shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be as follows:

Item	Diameter of Hole

Reinforcing Bars and Threaded Rod Anchors	3 mm larger than the outside diameter of the bar or the rod
Headed Anchor Bolts	Bolt diameter plus 50 mm and sufficient to clear the bolt head.

3.3.4 The embedment depth for epoxy grouted anchor bolts, threaded rod anchors and reinforcing bars shall be at least 15 bolt, rod or bar diameters, unless otherwise indicated on the drawings.

3.3.5 Holes shall be prepared for grouting as recommended by the epoxy grout manufacturer.

3.3.6 Installation: Anchor bolts, threaded rod anchors and reinforcing bars shall be clean, dry and free of grease and other foreign matter when installed. The bolts, rods and bars shall be set and positioned and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with epoxy grout, without voids.

3.4 Adhesive Anchores

3.4.1 When adhesive anchors are indicated on the drawings, only an acceptable system shall be used. Alternative anchoring systems may be used only when acceptable to Engineer. An acceptable adhesive anchor system may be used as an alternative in locations where epoxy grouted anchor bolts and threaded rod anchors are specified or indicated. The embedment depth for adhesive anchors shall be at least 15 rod diameters unless a greater depth is indicated on the drawings or as required by the product manufacturer.

3.4.2 Adhesive for adhesive anchors shall be statically mixed in the field during application. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

3.4.3 Anchors shall be installed in holes drilled into hardened concrete or grout filled masonry. Diameter of holes shall be 3 mm larger than the outside diameter of the rod unless recommended otherwise by the anchor system manufacturer. Holes shall be prepared for insertion of the anchors by removing all dust and debris using procedures recommended by the adhesive manufacturer.

3.4.4 Adhesive anchors and holes shall be clean, dry and free of grease and other foreign matter at the time of installation. The adhesive shall be placed, the rods shall be set and positioned and the adhesive shall be finished, all in accordance with the recommendations of the material manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with adhesive, without voids and remain filled with adhesive until completion of the curing period. Adhesive shall be cured in accordance with the recommendations of the adhesive manufacturer.

3.5 Expansion Anchors

3.5.1 When expansion anchors are indicated on the drawings, only an acceptable expansion anchor shall be used. Alternative systems may be used only when acceptable to Engineer. Expansion anchors shall be installed in accordance with the drawings, but in no case shall the depth of the hole be less than six (6) bolt diameters. The minimum distance between the centre of any expansion anchor and an edge or exterior corner of concrete shall be at least six (6) times the diameter of the bolt. Unless otherwise indicated on the drawings, the minimum distance between the centres of expansion anchors shall be at least 12 times the diameter of the bolt.

3.6 Quality Control

3.6.1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.

3.6.2 All post-installed anchors shall be installed by an installer trained for that specific product by a manufacturer's field representative. All training must be conducted on the jobsite prior to the installation of any products. A record of training must be submitted to the Engineer per the submittal instructions.

3.6.3 All adhesive anchor installations in the horizontal to vertically overhead orientation shall be conducted by a certified Adhesive Anchor Installer (AAI) as certified by ACI-CRSI Adhesive Anchor Installer Certification program or approved equivalent. Current AAI Certificate must be submitted to the Engineer for approval prior to commencement of any adhesive anchor installations.

3.6.4 Bring to the attention of the Consultant any defects in the work or departures from the contract documents that may occur during construction. The Consultant will decide upon corrective action and give his recommendations in writing.

3.6.5 The Consultant's general review during construction and inspection and testing by independent inspection and testing agencies reporting to the Consultant are both undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.

3.7 Notification

3.7.1 Prior to commencing significant segments of the work, give the Consultant and independent inspection and testing agencies appropriate notification, so as to afford them reasonable opportunity to review the work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective.

3.8 Inspection and Testing

3.8.1 Appointment of Independent Inspection and Testing Companies:

.1 The Owner will appoint the independent inspection and testing companies to make inspections or perform tests as the Consultant directs. The independent inspection and testing companies shall be responsible only to the Consultant and shall make only such inspections or tests as the Consultant may direct.

.2 When defects are revealed, the Owner may request, at the Contractor's expense, additional inspection or testing to ascertain the full extent of the defect.

3.8.2 Tests on Installed Anchors/rebar:

.1 Anchors/rebar: The independent inspection and testing company may test up to 10 precent of some of the installed anchors/rebar to the manufacturer's specified working load. Should defective anchors/rebar or under-capacity installations be found a higher percentage will be tested at the Contractor's expense.

3.9 Defective Materials and Work

3.9.1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength made and the like in order to help determine whether the work must be repaired or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the Consultant's opinion, the work may be acceptable.

3.9.2 All testing shall be conducted in accordance with the requirements of the Ontario Building Code, except where this would in the Consultant's opinion cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.

3.9.3 Materials or work which fails to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION

DIVISION 6 – WOOD AND PLASTICS

Section No.	Title
06101	Rough Carpentry
06310	Prefabricated Wood Roof Trusses
06610	Fibreglass Reinforced Plastics

1 GENERAL

1.1 Intent

1.1.1 This section describes the materials and procedures for the installation of rough carpentry including but not limited to miscellaneous interior carpentry, blocking, rough in framing and equipment mounting panels.

1.2 Related Specification Sections

1.2.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 05550 - Anchorage in Concrete and Masonry

.2 07311 – Asphalt Shingles

.3 Section 07900 – Joint Sealants

1.3 References

1.3.1 Ontario Building Code (OBC)

1.3.2 Canadian Standards Association (CSA):

.1 CSA O121-17 - Douglas Fir Plywood

.2 CSA O141-05 (R2014) - Softwood Lumber

.3 CSA O151-17 - Canadian Softwood Plywood

.4 CAN/CSA-O80 SERIES-15 CONSOLIDATED - Wood Preservation

.5 CAN/ULC-S102-18- Standard Method of Test for Surface Burning Characteristics of Building Material Assemblies.

1.3.3 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM F1667-20 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples

1.3.4 National Lumber Grades Authority (NLGA):

.1 Standard Grading Rules for Canadian Lumber (2014 Edition)

1.4 Quality Assurance

1.4.1 Lumber identification: by Grade Stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

1.4.2 Plywood identification: by grade mark in accordance with applicable CSA standards.

1.4.3 "Treated" and "fire treated" identification: by grade mark in accordance with the Canadian Wood Preservers Bureau.

1.5 Delivery Storage and Handling

1.5.1 Store lumber in a dry place and protect from dampness and damage

1.5.2 Store lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

2 PRODUCTS

2.1 Lumber Material

2.1.1 Lumber: unless specified otherwise, softwood, SPF 1/2, moisture content 19 percent or less, in accordance with the following standards:

.1 CSA O141

.2 NLGA Standard Grading Rules for Canadian Lumber.

.1 Light Framing: Species Group D, Standard Grade.
.2 Studding: Species Group D, Stud Grade.
.3 Structural Light Framing: Species Group D, No. 1 Grade.
.4 Appearance Lumber: Species Group B, Appearance Grade.
.5 Hardwood Lumber: Of grade conforming to grading rules of U.S. National hardwood Lumber Association, solid Yellow Birch, select or better
.6 Concealed Framing Lumber: No. 2 White Pine, No. 2 Red Pine, or No. 1 Construction Eastern Spruce, Balsam Fir or Jack Pine, kiln dried, free from sap, shakes, splits, knots and other defects.
.7 Grounds, Nailing Strips, Blocking Furring, rough bucks, cants, curbs, fascia backing and sleepers: No 2 White Pine, No. 2 Red Pine, or No. 1 Construction Eastern Spruce, kiln dried, free from sap, shakes, splits, knots and other defects.

.3 Glue: Waterproof

.4 Field Applied Wood Preservative: For field cut ends, supply "Wolman End Cut" by Koppers Company Inc. or same CCA preservative as used for shop impregnation.

.5 "Treated" Wood and Plywood (Decay and Termite Resistant):

.1 Koppers Company Inc., Womanized, Distributed by Hickson Building Products Limited.
.2 Timber Specialties K-33
.3 Provide vacuum/pressure impregnated lumber treated in accordance with CSA O80.
.4 Retention/Penetration Standards: Conform to CSA O80.
.5 Provide treated wood kiln dried to maximum 19% moisture content.
.6 Cut end liquid wood preservative as recommended by manufacturer of treated wood.

.6 "Fire Treated" Wood and Plywood:

.1 Koppers Company Inc., Dricon, Distributed by Hikson Building Products Limited.

.2 Timber Specialties Flame Proof LHC.
.3 Flame Spread: Max 25 in 30 minutes in accordance with CAN/ULC-S102.
.4 Provide fire treated wood kiln dried to max 19% moisture content.
.5 Do not resurface or rip fire treated wood if it affects the ULC label.
.6 Provide fire treated material bearing the stamp of the Canadian Wood Preservers Bureau and the ULC stamp.
.7 Interior Fire-Retardant Treatment Lumber and Plywood: Pressure treated lumber and plywood with fire retardant chemicals to meet an UL-fr-5 rating with a surface-burning characteristics rating of 25 or less for flame spread, fuel contributed and smoke developed. Ensure each piece of fire retardant treated lumber and plywood bears a ULC label or imprint attesting to this rating.

2.2 Panel Materials

2.2.1 Exterior Plywood: 19 mm (3/4”) thick, waterproof, grade stamped exterior grade Douglas Fir plywood (DFP), select grade, unsanded conforming to CSA O121.

2.2.2 Canadian softwood plywood (CSP): to CSA O151, standard construction.

2.3 Accessories

2.3.1 Rough Hardware: Supply rough hardware to frame and fix rough carpentry. This includes bolts, anchors, nails, expansion shields and other fastenings required. Hot dip galvanize hardware for exterior work; elsewhere, provide cadmium plated hardware. Provide spiral thread nails except as indicated otherwise.

2.3.2 Nails, spikes and staples: to ASTM F1667.

2.3.3 Bolts: 12.5 mm diameter, unless indicated otherwise, complete with nuts and washers.

2.3.4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

2.4 Finishes

2.4.1 Galvanizing: to ASTM A123/A123M, use galvanized fasteners for exterior work, interior highly humid areas, pressure-preservative, fire-retardant, treated lumber.

2.4.2 Stainless steel: use stainless steel 316 alloy, as indicated.

2.5 Wood Preservative

2.5.1 Pressure treated lumber CAN/CSA O80 Series to average net retention of 4.0 kg/m^3 of CCA preservative.

2.5.2 Pressure treated plywood CAN/CSA O80 to average net retention of 4.0 kg/m^3 of CCA preservative.

3 EXECUTION

3.1 Examination

3.1.1 Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Engineer in writing of any conditions which would be detrimental to the installation.

3.1.2 Beginning of installation indicates acceptance of site conditions.

3.2 Preparation

3.2.1 Treat surfaces of material with wood preservative, before installation.

3.2.2 Apply preservative by dipping or by brush to completely saturate and maintain wet film on surface for minimum three (3) minute soak on lumber and one (1) minute soak on plywood.

3.2.3 Retreat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

3.2.4 Mix intumescent paint coating product to manufacturer's recommendations. Do not thin or stain. Apply primer and paint coating providing fire resistant barrier in accordance with manufacturer's recommendations to achieve requirements of authorities having jurisdiction.

3.2.5 Treat material as indicated:

.1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.

.2 Wood furring and framing on outside surface of exterior masonry and concrete wall.

3.3 Installation

3.3.1 Comply with requirements of the OBC, supplemented by the following paragraphs.

.1 Properly frame together parts of the work with members accurately cut to size, closely fitted, well spiked and erected in a substantial manner, plumb, level, square and true to dimension.

.2 Install furring and blocking as required to space out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work, as required.

.3 Locate joints over bearing or supporting surfaces.

.4 Provide running members full length wherever possible.

.5 Design for expansion and contraction of the materials.

.6 Install wood frame backing as shown on the drawings.

.7 Install prefabricated roof trusses, plywood sheathing and any related framing, as required to complete installation.

.8 Align and plumb faces of furring and blocking to tolerance of 1:600.

.9 Install rough bucks, nailers and linings to rough openings, as required to provide backing for frames and other work.

.10 Install wood cants, fascia backing, nailers, curbs and other wood supports, as required, and secure using galvanized steel fasteners.

.11 Install sleepers as indicated.

.12 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.13 Countersink bolts where necessary to provide clearance for other work.

.14 Provide electrical equipment backboards for mounting electrical equipment as indicated. Use 19 mm thick plywood on 19 mm x 38 mm furring around spacing, perimeter and at maximum 300 mm intermediate.

3.4 Post-Installation

3.4.1 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Engineer at no cost to Owner.

3.5 Cleaning

3.5.1 Clean in accordance with Section 01740- Cleaning.

3.5.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

3.5.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

3.5.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

.2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.1 Scope of Work

1.1.1 Design, labour, Products, equipment and services necessary for the pre-fabricated wood roof trusses Work in accordance with the Contract Documents.

1.2 References

1.2.1 Ontario Building Code (OBC)

1.2.1 CSA O86-19 - Engineering Design in Wood

1.2.2 CSA O121-17(R2022) - Douglas Fir Plywood

1.2.3 Truss Plate Institute of Canada (2019) - Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses

1.2.4 ASTM A653/A653M-23 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.2.5 ASTM A879/A879M-22 - Standard Specification for Steel Sheet, Zinc-Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

1.3 Fabricator's Qualifications

1.3.1 Fabricator of wood trusses shall be a franchised manufacturer with design and specifications prepared by a Professional Engineer registered in the Province of Ontario. The design and shop drawings, as well as the fabrication of wood trusses, will be subject to inspection and approval of the Engineer at all times.

1.4 Design Requirements

1.4.1 All truss designs shall bear the seal of a Professional Engineer registered in the Province of Ontario.

1.4.2 The trusses shall be designed for loads specified and for wind uplift loads using "commercial" design designation.

1.4.3 Tolerate a deflection of span/180 due to serviceability loads combinations.

1.4.4 Importance Category: Post Disaster.

1.5 Submittal

1.5.1 Shop Drawings:

.1 Submit shop drawings, in accordance with Section 01330 – Submittal Procedures.

1.5.2 Truss drawings shall include the following information:

.1 Pitch, span, dimensions and spacing of truss;

.2 Truss bearing locations, design loading of truss and allowable stress increase;

.3 Axial forces in each truss member;

.4 Nominal sizes and location of connector plates at all joints;

.5 Sizes, species and stress grade of lumber for all truss members; and

.6 Permanent lateral bracing, as required by design, to reduce buckling length of individual truss members only.

1.5.3 Shop drawings shall clearly indicate material being supplied and shall show all connections, attachments, reinforcing, anchorage and location of exposed fastenings.

1.5.4 The shop drawings shall include a layout of the trusses and the fabrication and design details, including loading, as specified on the drawings.

1.5.5 Coordinate truss layout with all roof penetrations and access openings.

2 PRODUCTS

2.1 Materials

2.1.1 Lumber:

.1 All lumber used for truss members shall conform to the published stress ratings for the appropriate species and grades set out in the official grading rules of the appropriate lumber association or as listed in the reference specifications.

.2 Wherever this specification or notes on the plans or truss engineering design calls for lumber, which exceeds the minimum set forth therein, the specifications, plans and/or truss engineering designs shall be applicable. The information stated or shown in one shall be applicable the same, as if stated in all of them.

.3 All lumber shall conform to the recognized nominal sizes shown on the plans or truss engineering design.

.4 All members shall be cut from lumber that bears the proper Grade Mark stamps of a recognized grading association or licensed lumber inspection agency.

.5 No lumber shall be used that does not appear to conform to the proper dimensions and/or grades.

2.1.2 Connectors:

.1 All truss connector plates shall be manufactured from ASTM A653/A653M, Grade A prime commercial quality galvanized sheet steel, of no less than 20 gauge thickness, that has a minimum yield of 227.53 MPa and a minimum ultimate tensile strength of 310.27 MPa.

.2 The corrosion resistant coating shall follow ASTM A653/A653M,", Coating Designation G90 or G60, or ASTMA879/A879M, Coating Type C, of such treatment as will give equivalent corrosion protection.

2.1.3 Sheathing

.1 Unless noted otherwise, all roof sheathing shall be:

.1 CSA O121-17(R2022) DFP 15.5 mm Plywood for sloped surfaced beyond 15º Slope.
.2 CSA O121-17(R2022) DFP 22.5 mm Plywood for flat surfaces or with pitched surfaces 15º or less.

3 EXECUTION

3.1 Scope of Work

3.1.1 The work shall include the furnishing of all materials, equipment and labour necessary for the prefabrication, delivery and permanent setting of the wood trusses in the building.

3.1.2 The work shall include the supply and installation of all the miscellaneous parts, including bridging, temporary and permanent bracing and all related items of hardware, metal hangers, anchors and special metal shapes, deemed by the Structural Engineer or the Truss Design Engineer, to be necessary for the proper fabrication, erection, assembly, supporting and anchoring of the wood trusses, except that metal parts or items, which are to be embedded in concrete or fastened to the structural steel, shall be installed by the appropriate Sub-Contractors.

3.1.3 The work shall include the supply and installation of the plywood roof sheathing.

3.2 Fabrication

3.2.1 Fabricated trusses and sub-components shall be so handled and stored that they are not subject to damage. If the trusses are to be stockpiled prior to erection, sufficient bearing points and/or bracing shall be provided to prevent excessive lateral bending or tipping over.

3.2.2 Framing anchors and/or truss hangers shall be provided by the Contractor in accordance with architectural drawings and/or engineering drawings.

3.2.3 Field erection of the trusses, including items such as proper handling, safety precautions, temporary bracing to prevent tipping and buckling of the trusses during erection and any other safeguards or procedures consistent with good workmanship and good building erection practices, shall be the responsibility of the Contractor.

3.2.4 During the entire construction period, all Contractors shall provide means for adequate distribution of concentrated loads so that the carrying capacity of any one truss and/or other component is not exceeded.

3.2.5 Proper erection bracing shall be installed to hold the trusses true and plumb, in safe condition, until permanent truss bracing and bridging can be solidly nailed in place, to form a structurally sound roof framing system. All erection and permanent bracing shall be installed and all components permanently fastened before the application of any loads. Care shall be exercised to prevent excessive lateral bending of trusses during all stages of work.

3.2.6 The permanent structural cross-bracing, to ensure the overall rigidity of the roof system, shall be in accordance with the structural drawings for the building.

END OF SECTION

1 GENERAL

1.1 Scope of Work

1.1.1 The Contractor shall furnish, fabricate (where necessary) and install all fibreglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein and in accordance with the requirements of the Contract Documents.

1.2 References

1.2.1 American Society for Testing and Materials (ASTM):

.1 ASTM D495-14 - Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation

.2 ASTM D635-14 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

.3 ASTM D638-14 - Standard Test Method for Tensile Properties of Plastics

.4 ASTM D696-16 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30° with a Vitreous Silica Dilatometer

.5 ASTM D790-15e2 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

.6 ASTM D2344/D2344M-16 - Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

.7 ASTM E84-16 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.2.2 Ontario Building Code 2024

1.2.3 American National Steel Institute (ANSI) and National Sanitation Foundation (NSF):

.1 NSF/ANSI 61-2020 - Drinking Water System Components – Health

1.3 Submittals

1.3.1 The Contractor shall furnish shop drawings of all fabricated items and accessories in accordance with the provisions of this section.

1.3.2 All submittals, calculations and drawings sealed by a Professional Engineer registered in the province of Ontario.

1.3.3 All documentations shall be prepared in Metric (SI) units. Documentations prepared in Imperial units will not be accepted.

1.3.4 The Contractor shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles,color part or catalogue numbers, complete details for the fabrication and

erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes and connection details.

1.3.5 The Contractor shall submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables and design calculations for systems not sized or designed in the Contract Documents. Add additional supports as required.

1.3.6 The Contractor may be requested to submit sample pieces of each item specified herein for acceptance by the Engineer as to quality and color. Sample pieces shall be manufactured by the method to be used in the work.

1.3.7 Submit NSF-61 Standard Certifications.

1.4 Quality Assurance

1.4.1 All items to be provided under this section shall be furnished only by manufacturers having experience in the design and manufacture of similar products and systems. If requested, experience shall be demonstrated by a record of at least five (5) previous separate, similar successful installations in the last five (5) years.

1.5 Product Delivery and Storage

1.5.1 Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry, indoor storage facility.

1.5.2 Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations and other types of damage. Store items in an enclosed area and free from contact with soil and water. Store adhesives, resins and their catalysts and hardeners in dry indoor storage facilities between 21ºC to 29ºC until they are required.

1.5.3 WARRANTY

.1 Submit a two-year warranty for work for this Section against in materials and workmanship including, but not limited to:

.1 Performance failure of units.
.2 Fading, discoloration or evidence of other defects of exterior surface.

2 PRODUCTS

2.1 Design Criteria

2.1.1 General

.1 FRP shall be designed and constructed for a "post-disaster" importance category as defined in the OBC.

.2 FRP shall be designed to support dead, live, wind and earthquake loads, including contributions from pipes.

.3 Structure is to be designed with pinned connections to concrete, and sliding connections where shown on drawings.

2.1.2 Deflections

.1 Maximum deflection for total load is L/180.

.2 Maximum deflection for live load is L/360, but no more than 6mm.

2.1.3 Live Load

.1 FRP to support live loads as shown on drawings.

Design for concentrated live loads as specified in the OBC Table 4.1.5.9.

.3 Support pipes as shown on drawings and refer to Section 15060 Piping Supports for support type and spacing requirements.

.1 Specific gravity of pipe contents: 1.47

2.1.4 Earthquake Load

.1 Include loads from pipes and any equipment on the platforms in the seismic calculations.

.2 Pipe supports shall be designed and constructed for seismic loading to meet the requirements of the OBC clause 4.1.8.18. Elements of Structures, Non-Structural Components and Equipment, Division B-Part 4.

2.1.5 Environmental Conditions

.1 Splash and spill of chemical concentrations

.1 Sodium Hypochlorite 12%
.2

.2 Clean up time: maximum 48 hours

.3 Temperature: ambient, exposed to the elements.

2.2 Manufacturer

2.2.1 Acceptable manufacturers:

.1 Fibergrate Composite Structures Inc., Telephone: 1-800-263-3112

.2 Strongwell and distributed in Canada by Southwell Corp, Telephone: 1-877-984-7788

.3 Access Industrial Inc., Telephone: 905-602-4020

2.2.2 Products listed are by Fibergrate Composite Structures Inc., equal FRP Products by the approved manufacturers will be accepted.

.1 Structural shapes shall be Dynaform®

.2 Guardrail system shall be Dynarail™

.3 Ladder system shall be Dynarail™

.4 Molded gratings shall be Fibergrate®

.5 Pultruded Grating shall be Safe-T-Span®

.6 Stair treads shall be Fibertred®

.7 Embedment angle shall be FRP EZ embedment angle

2.3 General

2.3.1 All FRP items furnished under this section shall be composed of fibreglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

2.3.2 Fibreglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.

2.3.3 Resin shall be Isophthalic Polyester for all systems, except molded grating used in chemical storage or containment areas, which shall be Vi-Corr®, (vinyl ester resin system), with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.

2.3.4 All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, and free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibres shall be well covered with resin to protect against their exposure due to wear or weathering.

2.3.5 All FRP products shall have a tested flame spread rating of 25 or less per ASTM E84 Tunnel Test. Gratings shall also have tested burn time of less than 30 seconds and an extent of burn rate of less than or equal to 10mm per ASTM D635.

2.3.6 All mechanical grating clips shall be manufactured of Type 316 stainless steel.

2.4 Structural Shapes

2.4.1 All structural shapes are to be manufactured by the pultrusion process with a glass content minimum of 45 percent, maximum of 55 percent by weight for maximum sunlight and chemical resistance. The structural shapes shall be composed of fibreglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

2.4.2 Fibreglass reinforcement shall be a combination of continuous roving, continuous strand mat and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

2.4.3 Resins shall be DYNAFORM® ISOFR, fire retardant isophthalic polyester with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.

2.4.4 Pultruded structural shapes are to have the minimum longitudinal mechanical properties listed below:

Property	**ASTM Method**	**Value**	**Units**
Tensile Strength	D638	206 (30,000)	MPa (psi)
Tensile Modulus	D638	17.2 (2.5 x 10^6)	GPa (psi)
Flexural Strength	D790	206 (30,000)	MPa (psi)
Flexural Modulus	D790	12.4 (1.8 x 10^6)	GPa (psi)
Flexural Modulus (Full Section)	N/A	19.3 (2.8 x 10^6)	GPa (psi)
Short Beam Shear (Transverse)	D2344/D2344M	31 (4,500)	MPa (psi)
Shear Modulus (Transverse)	N/A	3.1 (4.5 x 10^5)	GPa (psi)
Coefficient of Thermal Expansion	D696	1.4 x 10^{-6} (8.0 x 10^{-6})	Cm/cm/°C (In/in/°F)
Flame Spread	E84	25 or less	N/A

2.5 Molded FRP Grating – Square Mesh

2.5.1 Manufacture: Grating shall be of a one (1) piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have a square mesh pattern providing bi-directional strength. Gratings shall be reinforced with rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 5 mm below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35 percent so as to achieve maximum corrosion resistance and as required to maintain the structural requirements of the Contract.

2.5.2 After molding, no dry glass fibre shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fibre orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

2.5.3 Non-slip surfacing: Grating shall be manufactured with a concave profile on the top of each bar providing maximum slip resistance. Secondarily applied grit shall be allowed as long as the top surface does not exceed 2 mm.

2.5.4 Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E84. Certifications shall be dated within the past two (2) years and test data performed only on the resin shall not be acceptable.

2.5.5 Resin system: The resin system used in the manufacture of the grating shall be VICOR®, a premium grade vinyl ester fire retardant resin. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.

2.5.6 Color: Dark Grey

2.5.7 Depth: 38mm with a tolerance of plus or minus 2 mm.

2.5.8 Mesh Configuration: 38 mm x 38 mm with a tolerance of plus or minus 2 mm mesh centre line to centre line.

2.5.9 Load/Deflection: Grating load/deflection requirements at the required span (shown below) shall be less than manufacturers published maximum recommended loads. Maximum recommended loads shall be determined by acoustic emission testing. Load/deflection not to exceed the following:

.1 Maximum deflection of span/360 or 6 mm under design loading shown on design drawings, whichever is less.

2.5.10 Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the Engineer for approval.

2.6 Pultruded Grating

2.6.1 Manufacture: Grating components shall be high strength and high stiffness pultruded elements having a maximum of 70 percent and a minimum of 60 percent glass content (by weight) of continuous roving and continuous strand mat fibreglass reinforcements. The finished surface of the product shall be provided with a surfacing veil to provide a resin rich surface which improves corrosion resistance and resistance to ultraviolet degradation. Bearing bars shall be interlocked and epoxied in place with a two piece cross rod system to provide a mechanical and chemical lock. Cross rods should be below the walking surface of the grating. Gratings with cross rods that are flush with the walking surface are excluded.

2.6.2 Non-slip surfacing: Grating shall be provided with a quartz grit bonded and baked to the top surface of the finished grating product.

2.6.3 Fire rating: Grating shall be fire retardant with a tested flame spread rating of 15 or less when tested in accordance with ASTM E84. Manufacturer may be required to provide certification of ASTM E84 test on grating panels from an independent testing laboratory. Test data shall be from full scale testing of actual production grating, of the same type and material supplied on the project. Test data performed only on the base resin shall not be acceptable.

2.6.4 Resin system: The resin system used in the manufacture of the grating shall be VEFR or ISOFR to suit applicable design. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating corrosion resistance and shall not be accepted.

2.6.5 Colour: Gray or Yellow.

2.6.6 Depth: 38 mm deep load bars with a tolerance of plus or minus 0.8 mm or as required to meet loads, or as indicated on the drawings.

2.6.7 Mesh Configuration: 38 mm load bar spacing, 152 mm tie bar spacing on centres. Grating shall be SAFE-T-SPAN® as manufactured by Fibergrate Composite Structures Incorporated.

2.6.8 Load/Deflection: Grating load/deflection requirements at the required span (shown below) shall be less than manufacturers published maximum recommended loads. Load/deflection not to exceed the following:

.1 Uniform distributed load of 4.8 kN/m^2 on grating with maximum deflection of span/360 or 6 mm, whichever is lesser.

.2 Concentrated line load of 14.4 kN/metre of width on grating with maximum deflection of span/360 or maximum deflection of 6 mm whichever is lesser.

2.6.9 Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the engineer for approval.

3 EXECUTION

3.1 General

3.1.1 Measurements

.1 FRP Structures and systems supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in the field for work fabricated to fit field conditions as required by manufacturer to complete the work. When field dimensions are not required, Contractor shall determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.

3.1.2 Sealing

.1 All shop fabricated cuts, drilled holes, etc. shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated cuts, drilled holes, etc. shall be coated similarly by the Contractor in accordance with the manufacturer's instructions.

3.1.3 Hardware

.1 All hardware shall be Type 316 stainless steel. Type 316 stainless steel holddown clips shall be provided and spaced at a maximum of 1220 mm apart with a minimum of four (4) per piece of grating or as recommended by the manufacturer.

3.2 Grating

3.2.1 Layout

.1 Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the Contract Drawings and coordinated with other trades. Provide additional framing as required to support these openings.

.2 Grating openings, which fit around protrusions (pipes, cables, machinery, etc.), shall be discontinuous at approximately the centre line of opening so each section of grating is readily removable.

.3 Gratings shall be fabricated free from warps, twists or other defects that affect appearance and serviceability.

.4 Gratings shall be fabricated in panels that can be easily handled by plant personnel. Unless otherwise indicated on the drawings, the weight of individual panels shall not exceed 35 kg.

3.3 Inspection

3.3.1 Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor, prior to the beginning of any fabrication work, so that inspection may be provided. The grating shall be as free as commercially possible from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).

3.4 Installation

3.4.1 Contractor shall install FRP structures in accordance with manufacturer's assembly drawings. Lock grating panels securely in place with hold-down fasteners as specified herein. Field cut and drill fibreglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fibreglass products or using resin products; provide adequate ventilation.

END OF SECTION

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

Section No.	Title
07110	Sheet Waterproofing Membrane
07160	Sheet Vapour Retarders
07212	Board Insulation
07213	Batt and Blanket Insulation
07270	Self-Adhered Air Vapour Barrier Membrane
07311	Asphalt Shingles
07460	Fiber Cement Siding
07463	Aluminium Soffits and Trim
07620	Sheet Metal Flashing and Trim
07840	Fire Stopping
07900	Joint Sealants

1 GENERAL

1.1 Intent

1.1.1 This section describes the materials and procedures for sheet waterproofing membranes installed by all trades including work in relation to below grade foundations and buried chambers, tunnels or any other below grade concrete structures.

1.2 Related Sections

1.2.1 Section 03300 – Cast-in-Place Concrete

1.2.2 Section 07212 – Board Insulation

1.2.3 Section 07900 – Joint Sealants

1.3 References

1.3.1 American Society for Testing of Materials (ASTM):

.1 ASTM D1970/D1970M-21 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

.2 ASTM E96 / E96M-16 - Water Vapor Transmission of Materials

.3 ASTM D412-16 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension

.4 ASTM D882-18 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting

.5 ASTM E154/E154M-08a (2019) - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

.6 ASTM C578-19 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

1.3.2 Canadian General Standards Board (CGSB):

.1 CGSB 37.29-M89 – Rubber-Asphalt Sealing Compound

1.4 Quality Assurance

1.4.1 Submit in writing, a document stating that the applicator of the sheet waterproofing membranes specified in this section is recognized by the manufacturer as suitable for the execution of the work.

1.4.2 Perform work in accordance with the printed requirements of the membrane manufacturer and this specification.

1.4.3 Maintain one (1) copy of manufacturer instructions on site.

1.4.4 At the beginning of the work and at all times during the execution of the work, allow access to work site by the membrane manufacturer's representative.

1.4.5 Components used in this section shall be sourced from one (1) manufacturer, including sheet membrane, air/vapour barrier sealants, primers, mastics and adhesives.

1.4.6 Ensure products used are compatible with existing materials.

1.4.7 Mock-up

.1 Construct mock-up in accordance with Section 01450 – Quality Control.

.2 Where directed, construct typical exterior wall panel, 3 m long X 3 m wide, incorporating substrate, primer, waterproofing membrane and liquid sealant application.

.3 Allow 24 hours for inspection of mock-up before proceeding. Mock-up may remain as part of the work.

1.5 Administrative Requirements

1.5.1 Pre-installation meetings: comply with Section 01300- Administrative Requirements. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Verify project requirements, including mock-up requirements.

.2 Verify substrate conditions.

.3 Co-ordinate products, installation methods and techniques.

.4 Sequence work of related sections.

.5 Co-ordinate with other building sub-trades leaving all chases, slots and reglets and building-in all frames, sleeves, anchors, bolts, etc. as supplied by others and to ensure proper installation and site preparation.

.6 Review manufacturer's installation instructions.

.7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.

.8 Review warranty requirements.

1.5.2 Sequencing: sequence with other work in accordance with Section 01130 Work Sequences and Tie-Ins.

1.6 Submittals

1.6.1 Prior to commencing the work, submit copies of manufacturer's current certification to ISO 9002. Membrane, primers, sealants, adhesives and associated auxiliary materials shall be included.

1.6.2 Prior to commencing the work, submit references clearly indicating that the materials proposed have been installed for not less than five (5) years on projects of similar scope and nature. Submit references for a minimum of 10 projects.

1.6.3 Prior to commencing the work, submit manufacturer's complete set of standard details for sheet waterproofing.

1.6.4 Alternatives

.1 Submit requests for alternatives in accordance with Section 01200 – Alternatives.

1.7 Delivery, Storage and Handling

1.7.1 Deliver material to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

1.7.2 Store roll materials horizontally in original packaging.

1.7.3 Store adhesives and primers at temperatures of 5°C and above to facilitate handling.

1.7.4 Keep solvent away from open flame and excessive heat.

1.7.5 Protect rolls from direct sunlight until ready to use.

1.8 Coordination

1.8.1 Ensure continuity of the waterproofing membrane throughout the scope of this section.

1.9 Warranty

1.9.1 For the work of this section, the 12 month warranty period prescribed in Section 01760 – Warranty Works is extended to **60 months**.

1.9.2 CONTRACTOR hereby warrants that the waterproofing membrane will stay in place and remain leakproof in accordance with Section 01760 – Warranty Works, but for two (2) years.

1.9.3 Waterproofing membrane manufacturer hereby warrants that the waterproofing membrane will remain in a watertight condition and will not leak as a result of faulty materials for a period of five (5) years. Scope of warranty shall include material required to return the membrane to a watertight condition.

2 PRODUCTS

2.1 Approved Manufacturers

.1 Henry Canada, 15 Wallsend Drive, Scarborough, Ontario, Canada, M1E 3X6, Phone: (800) 523-0268, e-mail: mclyde@henry.com, URL: www.bakor.com.

.2 SOPREMA Canada , 60 Sovereign Court, Woodbridge, Ontario, Canada L7L 6K8, Phone: (905) 265- 8088, e-mail:jharquail@soprema.ca, URL: www.soprema.ca.

.3 W.R Meadows of Canada, 70 Hannant Court, Milton, Ontario, Canada L9T 5C1, Phone: (905) 878-4122, e-mail: mmooney@wrmeadows.com, URL: www.wrmeadows.com.

.4 Equivalent products may be submitted for Engineer's approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.2 Materials

2.2.1 Self Adhered Waterproofing Membranes having the following physical properties:

.1 Thickness: 1.5 mm minimum.

.2 Flexibility: Pass @ -40°C to ASTM D1970/D1970M

.3 Vapour permeance: 2.8 ng/Pa.s.m^2 (0.05 perms) to ASTM E96/E96M.

.4 Tensile Strength (membrane): 2.24 MPa to ASTM D412.

.5 Tensile Strength (film): 34.5 MPa to ASTM D882.

.6 Elongation: 300 percent to ASTM D412.

.7 Puncture resistance: 200 N minimum to ASTM E154/E154M.

2.2.2 Acceptable products

.1 Blueskin WP 200 as manufactured by Henry Canada, SBS modified bitumen, self-adhering sheet membrane with cross-laminated polyethylene film.

.2 Mel-Rol as manufactured by W.R. Meadows, 56 mil thick layer of polymeric waterproofing membrane on a heavy duty, four-mil thick, cross-laminated polyethylene carrier film.

.3 Colphene 3000 as manufactured by Soprema, A 1.5 mm self-adhesive waterproofing membrane composed of SBS modified bitumen and a Tri-Laminate Woven Polyethylene facer. The self-adhesive side is covered by a silicone release sheet

2.2.3 Primer

.1 Primer for self-adhering waterproofing membrane having the following physical properties.

.1 Weight: 1.0 kg/l.

.2 Solids by weight: 53 percent.

.3 Water-based, no solvent odours.

.4 Drying time (initial set): 30 minutes.

.1 Acceptable products

.1 Aquatac Primer as manufactured by Henry Canada., a polymer emulsion based adhesive type, quick setting for temperatures above –40°C.

.2 MEL-PRIME as manufactured by W.R. Meadows,

.3 Sopraseal Stick Primer as manufactured by Soprema.

2.2.4 Primer for self-adhering waterproofing membrane having the following physical properties.

.1 Weight: 0.8 kg/l.

.2 Solids by weight: 35 percent.

.3 Drying time (initial set): 30 minutes

.1 Acceptable products

.1 Blueskin Primer as manufactured by Henry Canada, a synthetic rubber-based adhesive type, quick setting for all temperatures.

.2 A blend of elastomeric bitumen, volatile solvents, and adhesive enhancing resins used to prime porous substrates and non-porous substrates to enhance the adhesion of self-adhesive membranes at temperatures above -30°C.

2.2.5 Liquid Membrane

.1 Liquid membrane having the following physical properties.

.1 Compatible with sheet waterproofing membrane substrate and insulation materials.

.2 Solids by volume: 60 percent.

.3 Vapour permeance: 2.9 ng/Pa.m^2.s ASTM E96/E96M.

.4 Remains flexible with aging.

.5 Chemical resistance: Alkalis, calcium chloride, mild acid and salt solutions.

.1 Acceptable products

.1 Elasto-Seal LM as manufactured by Henry Canada, a cold-applied, one compound elastomeric waterproofing compound sealant designed to be used in conjuncture with sheet membrane.

.2 MEL-ROL LIQUID MEMBRANE as manufactured by W.R. Meadows, a two-component material.

.3 Hydralastic 836 for horizontal and vertical application as manufactured by W.R. Meadows, ------

.4 Sopraseal LM200 T as manufactured by Soprema, water based single component Air and vapour barrier liquid membrane.

2.2.6 Termination Sealant

.1 Sealant used to terminate edges of membrane with the following physical properties.

.1 Compatible with sheet waterproofing membrane, substrate and insulation materials.

.2 Solids by volume: 70 percent.

.3 Vapour Permeance: 2.9 ng/Pa.m^2s, ASTM E96/E96M.

.4 Complies with CGSB 37.29.

.5 Remains flexible with aging.

.6 Adheres to wet surfaces.

.7 Chemical resistance: Alkalis, calcium chloride, mild acid and salt solutions.

.1 Acceptable products

.1 Polybitume 570-05 Polymer Modified Sealing Compound as manufactured by Henry Canada, a polymer modified sealing compound

.2 Pointing mastic as manufactured by W.R. Meadows.

.3 Sopraseal Sealant as manufactured by Soprema, White solvent-based high-performance, moisture cure, solvent free polyether (STPE) sealant.

2.2.7 Protection Board

.1 Protection Board having the following physical properties.

.1 Thickness: 2 mm.

.2 Weight: 0.45 kg/m^2.

.3 Compression Strength: 0.45 kg/cm^2.

.1 Acceptable products

.1 990-31 Polypropylene Protection Board as manufactured byHenry Canada, a polypropylene extruded flexible twin-wall protection board.

.2 Protection Course as manufactured by W.R. Meadows.

.3 TREMDrain 1000 as manufactured by Tremco

.4 SOPRABOARD as manufactured by Soprema, 3.2 mm thick mineral fortified Asphalt core support panel formed between two layers of asphalt saturated glass mat.

.2 Protection Board Adhesive having the following physical properties.

.1 Compatible with waterproofing membrane and substrate.

.2 Long term flexibility: Pass ASTM C578.

.3 Chemical resistance: Alkalis, mild acid and salt solutions.

.1 Acceptable products

.1 230-21 Adhesive as manufactured byHenry Canada, a synthetic rubber-base compound.

.2 POINTING MASTIC as manufactured by W.R. Meadows, a solvent-based adhesive.

2.2.8 Drainage Board

.1 Drainage board: a dimple-raised moulded polystyrene fabric

.1 Acceptable products

.1 MEL-DRAIN, as manufactured by W.R. Meadows.

.2 Sopradrain 10 G as manufactured by Soprema, Polypropylene core high strength drainage panel with factory laminated geotextile.

3 EXECUTION

3.1 Examination

3.1.1 Verify that surfaces and conditions are ready to accept the work of this section. Commencement of the work or any parts thereof shall mean acceptance of the prepared substrate.

3.2 Preparation

3.2.1 All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar, frost or other contaminants. Fill spalled area in substrate to provide an even plane.

3.2.2 New concrete should be cured for a minimum of seven (7) days and must be dry before waterproofing membranes are applied. Lightweight structural concrete must be cured a minimum of 14 days.

3.2.3 Use appropriate waterproofing membrane primer as recommended by manufacturer based on air and surface temperature at time of application.

3.3 Primer

3.3.1 Apply primer for self-adhering membrane by roller or spray at rate recommended by manufacturer.

3.3.2 Allow minimum of 30 minutes open time. Primed surfaces not covered by waterproofing membrane during the same working day must be re-primed.

3.4 Joint and Crack Treatment

3.4.1 All cracks in concrete 1.5 mm to 3 mm wide are to be pre-treated with as per manufacturer's published recommendations.

3.4.2 Horizontal to vertical inside corner transition areas are to be pre-treated as per manufacturers published recommendations. Apply a minimum 225 mm strip of membrane centred at the joint.

3.4.3 All outside corners are to be pre-treated with a minimum 225 mm strip of membrane centred at the joint

3.4.4 Where three (3) or more planes come into contact, reinforce with cut sections of reinforcement sheet as per manufacturer's instructions.

3.5 Projections

3.5.1 Extend membrane tight to projection and seal with liquid membrane extending 65 mm along projection and 65 mm onto membrane.

3.6 Waterproofing Membrane – Vertical Applications

3.6.1 Apply waterproofing membrane to prepared substrate in lengths of 2400 mm or less.

3.6.2 Provide 65 mm laps at both sides and ends. Position for alignment and remove protective film. Press firmly into place. Promptly roll all laps with a countertop roller to effect seal. If more than one (1) length is required on a vertical surface, apply in a shingle fashion.

3.6.3 Terminate membrane using specified mastic/ sealant or terminator bar, reglet or counter flashing as indicated. Refer to manufacturer's standard details.

3.6.4 All laps within 300 mm of a 90º change in plane area are to be sealed with mastic/ sealant as per manufactures publish recommendations.

3.7 Protection of Finished Work

3.7.1 The waterproofing membrane is not designed for permanent exposure. Protect membrane from job site abuse as soon as possible following membrane application. Follow manufacturer's recommendations for the application of protection boards or drainage panels.

3.8 Cleaning

3.8.1 Clean in accordance with Section 01740- Cleaning.

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 This section describes the materials and procedures for sheet vapour retarders installed by all trades to provide a continuous barrier within the building envelope including work in relation to all openings through exterior walls / roofs, exterior service opening from electrical, mechanical and process.

1.2 Related Work

1.2.1 Section 03300 – Cast-in-Place Concrete

1.2.2 Section 04050 – Masonry Procedures.

1.2.3 Section 08110 - Steel Doors and Frames.

1.2.4 Divisions 15 Mechanical

1.2.5 Division 16 - Electrical

1.3 References

1.3.1 CAN/CGSB-51.33-[M89], Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

1.3.2 CAN/CGSB-51.34-M86 – M86 Vapour Barrier, Polyethylene Sheet, for Use in Building Construction

1.4 Submittals

1.4.1 Provide submittals in accordance with Section 01330 - Submittals.

1.4.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include:

.1 Product characteristics.

.2 Performance criteria.

.3 Limitations.

1.4.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

1.4.4 Quality assurance submittals:

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

1.5 QUALITY ASSURANCE

1.5.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Health and Safety Requirements.

1.5.2 Mock-Ups:

.1 Submit mock-ups in accordance with Section 01450 - Quality Control.

.2 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box. Mock-up may be part of finished work.

.3 Mock-up will be used to judge workmanship, substrate preparation, and material application.

.4 Allow 24 hours for inspection of mock-up by the Engineer before proceeding with vapour barrier work.

1.5.3 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of the finished work.

2 PRODUCTS

2.1 Sheet Vapour Barrier

2.1.1 Polyethylene film: to CAN/CGSB-51.34, 0.15 mm thick.

2.2 Accessories

2.2.1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

2.2.2 Sealants: compatible with vapour retarder materials, recommended by vapour retarder manufacturer.

2.2.3 Staples: minimum 6 mm leg.

3 EXECUTION

3.1 Installation

3.1.1 Ensure services are installed and inspected, prior to installation of retarder.

3.1.2 Provide a bead of caulking on the face of the wood framing prior to installing the sheet vapour retarder.

3.1.3 Install sheet vapour retarder on warm side of exterior assemblies, prior to installation of finishes, to form continuous retarder.

3.1.4 Use sheets of largest practical size to minimize joints.

3.1.5 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.2 Exterior Surface Openings

3.2.1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.3 Perimeter Seals

3.3.1 Seal perimeter of sheet vapour barrier as follows:

.1 Apply continuous bead of sealant to substrate at perimeter of sheets and at all interior framing.

.2 Lap sheet over sealant and press into sealant bead.

.3 Install staples through lapped sheets at sealant bead into wood substrate.

.4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.4 Lap Joint Seals

3.4.1 Seal lap joints of sheet vapour barrier as follows:

.1 Attach first sheet to substrate.

.2 Apply continuous bead of sealant over solid backing at joint.

.3 Lap adjoining sheet minimum 150 mm and press into sealant bead.

.4 Install staples through lapped sheets at sealant bead into wood substrate.

.5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.5 Cleaning

3.5.1 Clean in accordance with Section 01740- Cleaning.

3.5.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

3.5.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

3.5.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

.2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.1 Related Sections

1.1.1 Section 04050 Masonry Procedures

1.1.2 Section 07270 Self-Adhered Air Vapour Barrier Membrane

1.1.3 DIVISION 15 MECHANICAL

1.2 References

1.2.1 American Society for Testing and Materials (ASTM):

.1 ASTM C165-07 (R2017) – Recommended Practice for Measuring Compressive Properties of Thermal Insulations.

.2 ASTM C552-17e1 – Cellular Glass Thermal Insulation

.3 ASTM C578-19 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

.4 ASTM C612-14 (R2019) – Mineral Fiber Block and Board Thermal InsulationASTM C1396/C1396M-14a – Standard Specification for Gypsum Board

.5 ASTM D1621-16 – Test Method for Compressive Properties of Rigid Cellular Plastics.

.6 ASTM E84-20 – Test Method for Surface Burning Characteristics of Building Materials.

.7 ASTM E96/E96M-16 - Standard Test Methods for Water Vapour Transmission of Materials

1.2.2 Canadian Standards Association (CSA):

.1 CSA B149.1-20 - Natural Gas and Propane Installation Code

1.2.3 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC S701.1-2017 - Thermal Insulation, Polystyrene Boards

.2 CAN/ULC S704.1-2017 - Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced

.3 CAN/ULC S126-14 (R2019) - Standard Method of Test for Fire Spread Under Roof-Deck Assemblies

.4 CAN/ULC S604-2016 – Factory-Built Type A Chimneys

1.3 Quality Assurance

1.3.1 In addition to the requirements of 01450 – Quality Control, the following measures are required:

1.3.2 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

1.4 Submittals

1.4.1 Complete submittals in accordance with Specification Section 01330

1.4.2 Product Data:

.1 Submit product data for each type of product specified including manufacturer’s technical product data, installation instructions and recommendations for each type of roofing product required for the following items;

1.4.3 Test Reports:

.1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.5 Delivery Storage and Handling

1.5.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

1.5.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.5.3 Storage and Handling Requirements:

.1 In cold weather, store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect specified materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.6 Environmental and Site Conditions

1.6.1 Protect surfaces, and in particular the building cladding finishes, from being marred or contaminated by the materials. Examine the work of other Sections where such work is closely associated with the work of this Section and report any damage done to the work of this Section.

1.6.2 Protect work of this Section from damage due to high velocity winds until building cladding or other permanent protection is in place.

1.6.3 Maintain surface and ambient temperatures constantly between 10°C and 38°C during application and curing of adhesive except as permitted otherwise by the Contract Administrator in writing.

1.7 Warranty

1.7.1 Submit a two-year warranty for the Work of this Section against defects in materials, and workmanship including but not limited to integrity and continuity of the thermal, air and vapour barriers.

1.7.2 The contractor must submit a written warranty, signed and issued to the Owner, ensuring that the thermal, air, and vapor barriers will stay in place and perform as installed for at least 2 years from substantial completion..

2 PRODUCTS

2.1 Approved Manufacturers

.1 Dow Chemical Canada ULC Dow Building Solutions, 450 – 1st Street SW suit 2100, Calgary, Alberta, Canada, T2P 5H1, Phone: (866) 583-2583, URL: www.dowbuildingsolutions.com.

.2 Owens Corning, 3450 McNicoll Avenue, Scarborough, Ontario, Canada, M1V 1Z5, Phone: (905) 679-8120, e-mail:Tyler.simpson@owenscorning.com, URL: www.owenscorning.ca.

.3 SOPREMA Canada , 60 Sovereign Court, Woodbridge, Ontario, Canada L7L 6K8, Phone: (905) 265- 8088, e-mail:jharquail@soprema.ca, URL: www.soprema.ca.

.4 T. Clear Corporation, 3255 Symmes Road, Hamilton, OH 45015, Phone: (513) 870-9246, e-mail: sales@tclear.com, URL: www.tclear.com

2.1.2 Equivalent products may be submitted for Engineer's approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.2 Materials

2.2.1 **Perimeter Foundation Insulation**: Extruded polystyrene board to ASTM C578

.1 (CAN/ULC-S701) Type 4, rigid, closed cell, with integral high-density skin, c/w integral 5/16" (8mm) thick latex-modified concrete facing.

.1 Thermal Resistance: Long term aged R-value of 5per inch (0.03m2 K/W per mm), to ASTM C 518

.2 Board Size: 2' x 4' x 2 5/16" or 3 5/16" (610mm x 1219mm x 59mm or 84mm)

.3 Compressive Strength: to ASTM D 1621, minimum 40psi (275.6 kPa)

.4 Water Absorption: to ASTM D 2842, <0.1 (0.7% by volume max)

.5 Edges: Tongue and groove sides, square edge ends.

.6 Water Vapor Permeance: to ASTM E96, 0.8 (50 ng/Pas m2)

.7 Acceptable material:

.1 WallGUARD Wall Panels by T-Clear Corporation

.2 Metal Cap Flashing: 24ga (0.61mm) galvanized steel J-channel; 2 ¼" (57mm) wide, 4" (102mm) long leg and 2 ¼" (57mm) short leg; prefinished in color selected by Consultant, and supplied by other.

.3 Clips and Fasteners: corrosion-resistant type, sized to suit application; as supplied by insulation manufacturer.

2.2.2 Adhesive

.1 Adhesive for polystyrene: to CGSB 71-GP-24M,

.1 Type 2

.2 Class B

.3 Low VOC.

2.3 Accessories

2.3.1 Insulation clips: impale type, perforated 50 mm x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self-locking type.

3 EXECUTION

3.1 Examination

3.1.1 Ensure that surfaces to receive adhesive or insulation are dry, suitable for bond, and free from loose material, projections, ice, frost, grease, oil or other matter detrimental to bond of the adhesive or uniform bedding of the insulation.

3.1.2 Examine substrate and report unacceptable conditions. Commencing work will imply acceptance of substrate conditions.

3.2 Installation - General

3.2.1 Install materials in accordance with the manufacturers' printed instructions and as specified.

3.2.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

3.2.3 In construction separating interior from exterior, locate air and vapour barrier on the warm-in-winter side of the insulation.

3.2.4 Where hangers, anchors, and supports pass through insulation and vapour barrier construction, butter apertures with vapour barrier adhesive and ensure continuity of thermal and air and vapour barrier provisions.

3.2.5 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows, brick anchors and other protrusions and butter all edges.

3.2.6 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures and minimum 50 mm from sidewalls of CAN/ULC S604 Type A chimneys and CSA B149.1 Type B and L vents.

3.2.7 Cut and trim insulation neatly to fit spaces. Butt joints tightly and butter with vapour sealer, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

3.2.8 Offset both vertical and horizontal joints in multiple layer applications.

3.2.9 Do not enclose insulation until it has been inspected and approved by Engineer.

3.2.10 Provide protection as recommended by manufacturer to maintain integrity of installed insulation until facing materials are in place.

3.3 Installation - Mechanical Fasteners

3.3.1 Install clips to supplement adhesive attachment of insulation. Apply clips to concrete or steel or on underside of structural slab substrate using adhesive or, where accepted, using powder-actuated or pneumatic fixing or welded fastenings. Install mechanical fasteners 25 mm from end and edge of board at 600 mm o.c. and at the rate of one per square metre (one/10 ft²) for remainder of board.

3.3.2 Do not support insulation on clips until adhesive has set. Where insulation adhesive is to form a vapour barrier, arrange clips generally at 300 mm centres both ways. Where insulation occurs on the undersides of horizontal construction, provide each clip with a 50 mm diameter 0.47 mm galvanized steel washer before applying retainer.

3.3.3 For polyethylene or polyester faced air and vapour barrier torch apply clips and embed into air and vapour barrier.

3.3.4 Mechanical fasteners applied to steel air and vapour barriers, remove primer paint and adhere stick clips to clean, bare metal. Alternatively, use welded insulation clips.

3.4 Perimeter Foundation Insulation

3.4.1 Exterior application: extend boards 1200 mm minimum below finish grade, as indicated or to top of footing. Install on exterior face of perimeter foundation wall with adhesive.

3.5 Perimeter Insulation

3.5.1 Layout concrete-faced insulation boards to maximize board sizes. Do not use boards less than 6” (150mm) wide

3.5.2 Install concrete-faced insulation board system horizontally, complete with fastening clips and cap flashing in accordance with manufacturer’s installation guidelines.

3.6 Cleaning

3.6.1 Clean in accordance with Section 01740- Cleaning.

3.6.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

3.6.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

3.6.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

.2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.1 Summary

1.1.1 Provide glass fibre thermal insulation for roof and ceiling assembly as indicated on drawings.

1.2 Materials Provided in Other Sections

1.2.1 Section 06101 – Rough Carpentry

1.2.2 Section 06310 – Prefabricated Wood Roof Trusses

1.2.3 Section 07160 – Sheet Vapour Retarders

1.2.4 Section 07212 – Board Insulation

1.2.5 Section 07270 – Self-Adhered Air Vapour Barrier Membrane

1.3 References

1.3.1 American Society for Testing and Materials (ASTM):

.1 ASTM C165 – 07(2019) - Standard Test Method for Measuring Compressive Properties of Thermal Insulations.

.2 ASTM C167 -22 - Standard Test Method for Thickness and Density of Blanket or Batt Thermal Insulations.

.3 ASTM C177 -22 - Test Method for Steady-State Thermal Transmission Properties by means of the Guarded Hot Plate

.4 ASTM C356 - 17 - Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.

.5 ASTM C423 - 23 - Test Method for Sound Absorption and the Sound Absorption Coefficient by the Reverberation Room Method

.6 ASTM C518 - 21 - Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter

.7 ASTM C553 - 13 (2019) - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

.8 ASTM C612 - 14 (2019) - Standard Specification for Mineral Fiber Block and Board Thermal Insulation

.9 ASTM C665 – 17 - Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

.10 ASTM C795 – 08 (2018) - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.11 ASTM C1104/C1104M - 19 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.

.12 ASTM E84 - 20 - Test Method for Surface Burning Characteristics of Building Materials

.13 ASTM E90 – 09 (2016) - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.14 ASTM E96 / E96M - 16 - Test Method for Water Vapour Transmission of Materials

.15 ASTM E136 - 19a - Test Method for Behaviour of Materials in a Vertical Tube Furnace at 750°C

.16 ASTM E413 -16 - Classification for Rating Sound Insulation.

.17 ASTM E1050 -22 - Standard Test Method for Impedance and Absorption of Acoustical Materials Using a Tube, Two Microphones and a Digital Frequency Analysis System.

1.3.2 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S604-2016 – Standard for Factory-Built Type A Chimneys

.2 CAN/ULC S702-14 (R2019) - Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1.

.3 CAN/ULC S114-2018 - Standard Method of Test for Determination of Non-Combustibility in Building Materials.

.4 CAN/ULC S115-2018 - Standard Method of Test of Firestop Systems.

.5 CAN/ULC S102-2018 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.4 Quality Assurance

1.4.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.4.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4.3 Batt and Blanket Insulation Installer Quality Assurance: Work experience of 5 years minimum with work similar to work of this Section.

1.4.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Health and Safety Requirements.

1.5 Submittals

1.5.1 Product Data: Submit product literature, samples and installation instructions for specified insulation in accordance with Section 01330 – Submittal Procedures.

1.5.2 Manufacturer's Instructions:

.1 Submit product data including manufacturer's literature for insulation materials and accessories, indicating compliance with specified requirements and material characteristics.

.1 MSDS report.

.2 Include product name.

.3 Include preparation instructions and recommendations, installation methods, and storage and handling requirements.

.4 Include contact information for manufacturer and their representative for this Project.

1.5.3 Samples:

.1 Submit 140 x 190 mm minimum sample of insulation in thickness used on Project.

1.5.4 Test Reports:

.1 Submit evaluation service reports or other independent testing agency reports showing compliance with specified performance characteristics and physical properties.

1.5.5 Field Reports:

.1 Submit manufacturer's field reports within 3 days of each manufacturer representative's site visit and inspection

1.5.6 Insulation Installer Qualifications:

.1 Submit letter verifying insulation installer's experience with work similar to work of this Section.

1.5.7 Warranty:

.1 Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions.

1.5.8 Closeout Submittals

.1 Operation and Maintenance Data: Supply maintenance data for insulation materials for incorporation into manual specified in Section 01780 - Closeout Submittals.

1.6 Delivery

1.6.1 Comply with manufacturer's recommendations for handling, storage and protection during installation.

1.6.2 Deliver materials and accessories in insulation manufacture's original packaging with identification labels intact and in sizes to suit project.

1.6.3 Label insulation packages to include material name, production data and/or product code.

1.6.4 Protect insulation from physical damage and from becoming wet, soiled, or covered with ice or snow.

1.6.5 Replace wet or damaged insulation materials.

1.6.6 Storage and Handling Requirements:

.1 Store materials off ground in dry location and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

.2 Store in original packaging until installed.

1.7 Warranty

1.8 Warranty period: 1 years commencing on Date of Substantial Performance of Work.

2 PRODUCTS

2.1 Approved Manufacturers

.1 ROXUL INC., 420 Bronte Street South, Suite 105, Milton, Ontario, Canada, L9T 0H9, Phone: (416) 605-1528, Toll Free: 1-800-265-6878, e-mail: contactus@roxul.com, URL: www.rspec.com.

.2 Owens Corning Canada L.P., 3450 McNicoll Avenue, Scarborough, Ontario, Canada, M1V 1Z5, Phone: (416) 605-1528, e-mail: Tyler.simpson@owenscorning.com URL: www.owenscorning.ca.

.3 Fibrex Insulations, Inc., PO Box 2079, 561 Scott Rd., Sarnia, Ontario, Canada, N7T 7L4, Phone: 519-336-7770, Toll Free: 1-800-265-7514, URL: http://www.fibrex.on.ca

.4 Equivalent products may be submitted for Engineer's approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.2 Thermal Batt Insulation

2.2.1 Batt and Blanket Mineral Fibre (Ceiling Insulation):

.1 Type: friction fit, type 1, mineral fibre insulation to CAN/ULC-S702.

.2 Size: Wood Frame Insulation: as shown on the drawings unless specified otherwise.

.3 When tested in accordance with ASTM C518. Thickness 300 mm.

.4 Fire performance:

.1 Non-combustibility: To CAN/ULC S114.

.2 Surface Burning Characteristics: To CAN/ULC S102.

.1 Unfaced Insulation

.2 Maximum flame spread: 10

.3 Maximum smoke developed: 10

.5 Combustion Characteristics: Unfaced Insulation Passes ASTM E 136.

.6 Dimensional Stability: Linear shrinkage less than 0.1 percent.

2.2.2 Semi Rigid Stone Wool (Cavity Wall Insulation)

Type: Semi-rigid stone wool conforming to ASTM C612, minimum density 70kg/m3. ‘CladStone 45’ by John Manville, ‘Thermafiber Rainbarrier 45’ by Owens Corning, and ‘CavityRock’ by Rockwool..2 Thickness: as indicated on drawings

2.2.3 Fire Stopping: Insulation shall be Roxul AFB.

2.3 Accessories

2.3.1 Insulation clips:

.1 Impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

2.3.2 Nails: galvanized steel, length to suit insulation plus 25 mm, to CSA B111.

2.3.3 Staples: 12 mm minimum leg.

2.3.4 Tape: as recommended by manufacturer.

3 EXECUTION

3.1 Manufacturer's Instructions

3.1.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 Inspection and Preparation

3.2.1 Examine the areas and conditions under which work of this section will be installed. Verify that adjacent materials are firm, straight, smooth, dry, free of snow, ice or frost, clean of dust and debris. and ready to receive insulation.

3.2.2 Verify mechanical and electrical services within the above ceiling space have been tested and inspected.

3.2.3 Provide written report listing conditions detrimental to performance of work in this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2.4 Start of insulation installation indicates installer's acceptance of substrate installation conditions.

3.3 Installation

3.3.1 Install insulation in accordance with manufacturer's written recommendations.

3.3.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

3.3.3 Install acoustical insulation in stud cavities and above ceiling finishes indicted to receive insulation.

3.3.4 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.

3.3.5 Do not compress insulation to fit into spaces. Cut and trim insulation neatly to fit spaces.

3.3.6 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN4 S604 type A chimneys and CAN/CGA B149.1 and CAN/CGA B149.2 type B and L vents. At these locations use mineral wool batt insulation to fill gap between combustible insulation and heat emitting devices.

3.3.7 Use largest possible dimensions to reduce number of joints.

3.3.8 Do not enclose insulation until it has been inspected and approved by Engineer.

3.3.9 Firestopping Of Masonry Cavity Walls

.1 Install fire stopping in cavities in accordance with Dow Corning News Blueprint DCN 888, dated May 1995.

.2 Minimum thickness of rock wool insulation fire stopping before compression shall be 112 mm .

.3 Insulation edges immediately above or below fire stopping, where insulation edges are not secured using wedges, shall be secured using adhesives and impaling pins. Ensure insulation is in full contact with substrate.

3.4 Installation – Vapour Retarders

3.4.1 Maintain vapour retarder integrity by tightly abutting adjacent insulation. Repair punctures or tears in vapour retarder facing by taping. Follow type manufacturer's application recommendations.

3.4.2 Install insulation with factory applied vapour barriers facing the warm side of building spaces, and vapour permeable membrane facing the cold side. Lap end and side flanges of membrane over framing members. Retain in position with nails, staples, clips, as recommended by the manufacturer. Tape seal butt ends and lapped side flanges. Do not cut or tear vapour barrier.

3.5 Field Quality Control

3.5.1 Field Inspection:

.1 Coordinate field inspection in accordance with Section 01450 - Quality Control.

3.5.2 Manufacturer's Services:

.1 Coordinate manufacturer's services with Section 01450 - Quality Control.

.1 Arrange for payment for manufacturer's services.

.2 Have manufacturer review work involved in handling, installation, protection, and cleaning of insulation and accessories, and submit written reports in acceptable format to verify compliance of Work with Contract conditions.

.2 Manufacturer's Field Services:

.1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for product installation review in accordance with manufacturer's instructions.

.2 Report any inconsistencies from manufacturer's recommendations immediately to Engineer.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of drainage sheet and accessories, and when preparatory work on which Work of this Section depends is complete, but before installation begins.

.2 During progress of work at 50% completion.

.3 Upon completion of Work, after cleaning is carried out.

.4 Obtain reports within three days of review and submit immediately to Consultant.

3.6 Material Storage and Protection

3.6.1 Protect insulation from damage and from becoming wet before, during and after installation.

3.6.2 Repair damage to adjacent materials caused by insulation installation.

3.7 Cleaning

3.7.1 Clean in accordance with Section 01740- Cleaning.

3.7.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

3.7.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

3.7.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

.2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 This section describes the materials and procedures for sheet applied air barriers installed by all trades including work in relation to building veneers, all wall openings and penetrations.

1.1.2 Provide all articles, labour, materials, equipment and transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.

1.2 Related Specification Sections

1.2.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 01330 Submittals.

.2 Section 01450 Quality Control.

.3 Section 04211 Brick Unit Masonry

.4 Section 04220 Concrete Unit Masonry

.5 Section 06310 Prefabricated Wood Roof Trusses

Section 07212 Board Insulation

.6 Section 07213 Batt and Blanket Insulation

.7 Section 07460 Fiber Cement Siding

.8 Section 07900 Joint Sealants.

.9 Section 08110 Steel Doors and Frames.

.10 Divisions 15 and 16 Mechanical & Electrical

1.3 Code and Regulatory Requirements

1.3.1 All products shall conform to the following standards and regulations:

.1 ASTM International Inc.

.1 ASTM C1305-16(2023) - Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane

.2 ASTM E96/E96M-22 – Standard Test Methods for Water Vapor Transmission of Materials

.3 ASTM E283/E283M - 19 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.4 ASTM E330/E330M-14 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

.5 ASTM E331-00(2016) - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

.6 ASTM E1105-15 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference

.7 ASTM E1677-19 - Specification for Air Retarder (AR) Material or System for Low-Rise Framed Building Walls

.8 ASTM E2178-21 - Standard Test Method for Air Permeance of Building Materials

.9 ASTM E2357-18 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-19.13M-M87, Sealing Compound, One Component, Elastomeric Chemical Curing.

.2 CAN/CGSB-19.24M-M90, Multi-Component, Chemical Curing Sealing Compound.

.3 CGSB 19-GP-14M-84, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

.4 CGSB 37-GP-56M - Membrane, Modified, Bituminous, Prefabricated, and Reinforced.

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC S741-08(R2020) – Standard for Air Barrier Materials

.2 CAN/ULC S742-2020 - Standard for Air Barrier Assemblies

.4 Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.

1.4 Quality Assurance

1.4.1 In addition to the requirements of Section 01450 – Quality Control, the following measures are required:

1.4.2 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

1.4.3 Pre-installation meetings: comply with Section 01120 - Coordination and Sequence of Work. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:

.1 Owner;

.2 Engineer;

.3 All Affected Subcontractors;

.4 Manufacturer’s Technical Representative.

.2 Verify project requirements, including mock-up requirements.

.3 Verify substrate conditions.

.4 Co-ordinate products, installation methods and techniques.

.5 Sequence work of related sections.

.6 Co-ordinate with other building sub-trades to ensure proper installation and site preparation.

.7 Review manufacturer's installation instructions.

.8 Review warranty requirements.

1.4.4 Review manufacturer's installation instructions and warranty requirements.

1.4.5 Mock-up

.1 Construct mock-up in accordance with Section 01450 - Quality Control, Product Data and Samples.

.2 Coordinate mock-up requirements with specifications listed in section 1.2 - Related Specification Sections

.3 Construct typical exterior wall panel, 3 m long by 3 m wide, incorporating window, frame, sill, insulation, building corner condition and junction with roof system; illustrating materials interface and seals.

.4 Mock-up may remain as part of finished work.

.5 Allow 48 hours for inspection of mock-up by Engineer before proceeding with air/vapour barrier Work.

1.4.6 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.

.2 During progress of Work at 50% completion.

.3 Upon completion of Work, after cleaning is carried out.

1.5 Submittals

1.5.1 Complete submittals in accordance with Specification Section 01330

1.5.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets.

1.5.3 Provide shop drawings of special joint conditions.

1.5.4 Quality Assurance Submittals: submit following in accordance with Section 01450 - Quality Control.

.1 Existing Substrate Condition: report deviations, as described in PART 3 - EXAMINATION in writing to Engineer.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.3 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.5.5 Closeout Submittals: Provide maintenance data for cleaning and maintenance for incorporation into operations manual

1.5.6 Warranty: Submit unexecuted warranty for review

1.5.7 Alternatives

.1 Submit requests for alternatives in accordance with Section 01200 – Alternatives.

.2 Acceptable alternatives will be confirmed by addendum. Substitute materials not approved in writing prior to tender closing shall not be permitted for use on this project

.3 Alternate submission format to include:

.1 Submit evidence that alternate materials meet or exceed performance characteristics of Product requirements as well as documentation from an approved independent testing laboratory certifying that the air leakage and vapour permeance rates of the air/ vapour barrier membranes, including primary membrane and transition sheets, exceed the requirements of the National Building Code, ASTM E 2357, the Massachusetts Energy Code and in accordance with ASTM E 2178.

.1 Test report submittals shall include test results on porous substrate and include sustained wind load and gust load air leakage results.

.2 Test reports to be provided for both regular and low temperature grades.

.2 Submit manufacturers' complete set of standard details for air/vapour barrier membrane systems showing a continuous plane of air tightness throughout the building envelope.

1.6 Delivery Storage and Handling

1.6.1 Refer to Specification Section 01610 - Basic Product Requirements, stipulations.

1.6.2 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

1.6.3 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.4 Store role materials on end in original packaging.

1.6.5 Protect rolls from direct sunlight until ready for use.

1.6.6 Store adhesives and primers at temperatures of 5 degrees C and above to facilitate handling.

1.6.7 Keep solvent away from open flame or excessive heat.

1.6.8 Avoid spillage: immediately notify Engineer if spillage occurs and start clean up procedures.

1.6.9 Clean spills and leave area as it was prior to spill.

1.7 Environmental and Site Conditions

1.7.1 Refer to Specification Section 01610 - Basic Product Requirements stipulations

1.7.2 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.

1.7.3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.8 Sequencing

1.8.1 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.9 Warranty

1.9.1 In addition to the contractual warranty terms, Provide a total 60 month warranty from the date of substantial completion for all labour and materials for sealant and sheet materials covered under this specification.

1.9.2 Warranty: include coverage of installed sealant and sheet materials which:

.1 Fail to achieve airtight and watertight seal.

.2 Exhibit loss of adhesion or cohesion.

.3 Do not cure.

2 PRODUCTS

2.1 Design Criteria

2.1.1 ASTM E96 permeance maximum 0.03 US Perm (1.72 ng/s•m²•Pa)

2.2 Approved Manufacturers

.1 Henry Company, 15 Wallsend Dr. Scarborough, ON. M1E 3X6, Phone: (800) 486-1278, e-mail: productsupport@henry.com, URL: ca.henry.com.

.2 W.R. Meadows of Canada, 70 Hannant Court, Milton, Ontario, Canada L9T 5C1, Phone: (905) 878-4215, e-mail: wrmcan@wrmeadows.com, URL: www.wrmeadows.com.

.3 SOPREMA Canada , 60 Sovereign Court, Woodbridge, Ontario, Canada L7L 6K8, Phone: (905) 265- 8088, e-mail:jharquail@soprema.ca, URL: www.soprema.ca.

2.3 Materials

2.3.1 Flexible Membrane:

.1 Blueskin TG or SA, as manufactured by Henry Company, complete with all adhesives and primers and supplementary sealing materials.

.2 Air-Shield as manufactured by W.R. Meadows.

.3 Sopraseal Stick 1100 T as manufactured by Soprema

2.3.2 Masonry air/vapour barrier, including transitions to other materials and openings within masonry are to be provided with membrane flashings using Blueskin SA or AG with primer as manufactured by Henry, Air-Shield Thru-Wall Flashing as manufactured by W.R. Meadows or SOPRASEAL STICK 1100 T as manufactured by SOPREMA

2.3.3 Masonry cavity wall air and vapour barriers shall be compatible with through-wall flashings. Submit written confirmation of compatibility.

2.4 ACCESSORIES

2.4.1 Sealants in accordance with Section 07900 - Joint Sealants.

2.4.2 Adhesives, Sealants, Tape and Accessories for wall air and vapour barrier: as recommended by membrane manufacturer to achieve a complete and effective air and vapour barrier.

.1 Sealant Primer: recommended by sealant manufacturer, appropriate to application.

.2 Substrate Cleaner: non-corrosive, type recommended by sealant manufacturer, compatible with adjacent materials.

2.4.3 For adhering flexible membrane flashings to the wall air / vapour barrier (at edges, openings, etc.) use Airbloc 21 as manufactured by Henry, Pointing Mastic as manufactured by W.R. Meadows or SOPASEAL SEALANT as manufactured by SOPREMA.

2.4.4 For Adhering flexible membrane flashings to wood or metal, use Blueskin Adhesive as manufactured by Henry, Mel-Prime as manufactured by W.R. Meadows or SOPRASEAL STICK PRIMER as manufactured by SOPREMA.

3 EXECUTION

3.1 General

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.1.2 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.

3.1.3 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

3.1.4 Perform Work in accordance with Canadian Urethane Foam Contractor's Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.

3.2 Examination

3.2.1 Verify that surfaces and conditions are ready to accept work of this section.

3.2.2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.

3.2.3 Where curing compounds are used they must be clear resin based without oil, wax or pigments.

3.2.4 Report unsatisfactory conditions to Engineer in writing.

3.2.5 Do not start work until deficiencies have been corrected.

.1 Beginning of installation indicates acceptance of site conditions.

3.3 Preparation for Installation

3.3.1 Remove loose or foreign matter, which might impair adhesion of materials.

3.3.2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.

3.3.3 Ensure substrates are free of surface moisture prior to application of self-adhesive or membrane and primer.

3.3.4 New concrete should be cured for a minimum of 14 days and must be dry before barrier is applied.

3.3.5 Ensure metal closures are free of sharp edges and burrs.

3.3.6 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

3.3.7 Concrete surfaces should be free of large spalled areas and voids. Fill any large voids or spalled areas to provide and even plane.

3.3.8 Cracks in masonry and concrete should be sealed with a strip of air barrier membrane lapped a minimum of 75 mm on both sides of the crack.

3.3.9 Cement board and plywood joints should be taped.

3.4 Installation

3.4.1 Install materials in accordance with manufacturer's instructions.

3.4.2 Apply air barrier membrane to all connections of masonry block to steel or concrete; drywall or plywood to steel or concrete; and all beams, columns, window and door frames, etc. using strips of the air barrier lapped a minimum of 75mm on both substrates and centred over joint.

3.4.3 Adhesive or Primer for Transition and Through-wall Flashing Membrane (Self-Adhering)

.1 Apply adhesive or primer for self-adhering membranes at rate recommended by manufacturer.

.2 Apply to all areas to receive transition sheet and / or through-wall flashing membrane, as indicated on drawings by roller or spray and allow minimum 30 minute open time. Surfaces not covered by self-adhering transition membrane or self-adhering through-wall flashing membrane during the same working day must be re-applied.

.3 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.4.4 Transition Membrane (Self-Adhering)

.1 Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps.

.2 Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings

.3 Promptly roll all laps and membrane with a countertop roller to effect seal.

.4 Ensure all preparatory work is complete prior to applying liquid applied air vapour barrier membrane.

3.4.5 Through-wall Flashing Membrane & Dampproof Course (Self-Adhering)

.1 Apply through-wall flashing and dampproof coursing membrane in accordance with CSA A371-94 Masonry Construction for Buildings; along the base of masonry veneer walls, over windows, doors and other wall openings required to be protected.

.2 Applications shall form a continuous flashing membrane and shall extend up a minimum of 200 mm up the back-up wall.

.3 At the end of each days work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.

.4 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. At locations where flashing terminates or intersects wall openings including door frames, “end dam” flashing to protect openings and redirect water out. Trim off excess as directed by the consultant.

.5 Apply dampproof coursing membrane over slabs on grade, prepare and prime surfaces, align and position membrane between slab and masonry block work.

.6 Align and position the leading edge of self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls, self angles and other substrates to be protected, partially remove protective film and roll membrane over surface and up vertically.

.7 Press firmly into place. Ensure minimum 50 mm overlap at all end and side laps. Promptly roll all laps and membrane to affect the seal.

.8 Ensure all preparatory work is complete prior to applying self-adhering through-wall flashing membrane.

.9 Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.

3.4.6 Air/Vapour Barrier Membrane

.1 Use sheets of largest practical size to minimize joints

.2 Apply self-adhering membrane complete and continuous to prepared and primed substrate in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertical joints.

.3 Align and position self-adhering membrane, remove protective film and press firmly into place. Ensure minimum 50 mm overlap at all end and side laps. Promptly roll all laps and membrane with a countertop roller to affect the seal.

.4 At the end of each days work seal the top edge of the membrane where it meets the substrate using liquid air seal mastic. Trowel apply a feathered edge to seal termination and shed water.

.5 Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings. Refer to manufacturers' standard details.

.6 Any blocking required to install these items shall not interfere with the continuity of the air/vapour barrier

.7 Ensure all projections, including wall ties, are properly sealed with a caulk application of liquid air seal mastic.

.8 Mechanically fasten membrane through securement bars to all window, door, louvers and curtain wall sections as recommended by membrane manufacturer where proper adhesion and bonding cannot be maintained.

.9 Membrane applied to the underside of substrate surfaces shall receive special attention on application to ensure maximum surface area adhesion is obtained.

.10 Seal to roof vapour barrier at wall/roof intersection to create a continuous membrane.

3.4.7 Inspect sheets for continuity. Repair punctures and tears in air barrier with manufacturer's recommended repair before work is concealed.

3.4.8 Spray foam is not to be used to create the continuity of the air/vapour barrier between door/window frame and the exterior wall. If used the Contractor will be required to remove and re-install the frame in the correct manner at his own expense, and shall be responsible for the cost of the work of other trades affected by this replacement.

3.5 Field Quality Control

3.5.1 Notify engineer when sections of work are complete so as to allow for review prior to installing insulation.

3.5.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Section 01330 - Submittals.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 Protection of Work

3.6.1 Ensure finished work is protected from climatic conditions. Adhesive air/vapour barrier membrane cannot be left exposed to the elements. It must be covered immediately by insulation to prevent blistering or surface crazing of membrane in order to provide a positive bond for the insulation.

3.6.2 Do not permit adjacent work to damage work of this section.

3.7 Cleaning

3.7.1 Clean in accordance with Section 01740- Cleaning.

3.7.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

3.7.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

3.7.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

.2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.1 References

1.1.1 Canadian Roofing Contractors' Association (CRCA):

.1 CRCA Specification

1.1.2 Canadian Standards Association (CSA):

.1 CAN/CSA A123.1-05 / A123.5-05 (R2015) – Asphalt Shingles Made from Organic Felt and Surfaced with Mineral Granules / Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules

.2 CSA A123.51-14 – Asphalt Shingle Application on Roof Slopes 1:6 and Steeper

.3 CAN/CSA-B111-1974 – Wire Nails, Spikes and Staples

.4 CAN/CSA-A123.2-03 (R2013) – Asphalt Coated Roofing Sheets

1.2 Submittals

1.2.1 Submit proof of manufacturer's CCMC Listing and listing number to Engineer.

1.3 Product Date

1.3.1 Submit product data in accordance with Section 01330 – Submittal Procedures.

1.3.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS). WHMIS acceptable to Labour Canada and Health and Welfare Canada.

1.3.3 Submit product data sheets for asphalt shingles. Include:

.1 .1 product characteristics

.2 .2 performance criteria

.3 .3 installation instructions

.4 .4 limitations

.5 .5 colour and finish

1.4 Samples

1.4.1 Submit samples in accordance with Section 01330 – Submittal Procedures.

1.5 Delivery, Storage and Handling

1.5.1 Provide and maintain dry, off-ground weatherproof storage.

1.5.2 Remove only in quantities required for same day use.

1.6 Extra Materials

1.6.1 Submit maintenance materials in accordance with Section 01330 – Submittal Procedures.

2 PRODUCT

2.1 Materials

2.1.1 All materials required for the work of this section shall be the product of an established manufacturer and shall be approved by the Engineer.

2.1.2 All materials shall be delivered at building site in original package or containers with labels of manufacturer clearly visible. They shall conform to the following standards, including all revisions to date.

.1 Asphalt shingles shall be: 30-year standard weight and conform to CSA Standard A123.1, IKO Marathon Plus AR Series: Dual Black.

.2 Asphalt shingle nails: large head galvanized steel or aluminum roofing nails sufficient length to penetrate the deck approximately 19 mm.

.3 Ice and Watershield: continuous membrane manufactured by W.R. Grace and Co. Canada Ltd.

.4 Ice and Watershield and Peak/Valley Protection: Blueskin® ROOF RF 200 as manufactured by Henry Company.

.5 Rige vent: 12” filtered ridge ventas manufactured by CertainTeed.

.6 PVC drip edge: extruded profile of unplasticized polyvinyl chloride of minimum thickness of 0.8 mm.

.7 Nails: to CSA B111. Galvanized steel sufficient length to penetrate 19 mm into deck.

3 EXECUTION

3.1 Application

3.1.1 Install ice and water shield over entire surface of the roof to manufacturer’s specifications. Use two (2) layers of protective membrane on the valleys.

3.1.2 Do asphalt shingle work in accordance with CAN3-A123.52, except where specified otherwise and to manufacturer’s specifications.

3.1.3 Install drip edge along eaves, overhanging 12 mm, with minimum 50 mm flange extending onto roof decking. Nail to deck at 400 mm on centre.

3.1.4 Install bottom step flashing (soaker base flashing) interleafed between shingles at vertical junctions.

3.1.5 Install asphalt shingles on roof slopes 1:3 and steeper in accordance with CAN3 A123.51.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 Work under this section is subject to the provisions of the contract documents which in any way affect the work specified herein.

1.2 Scope

1.2.1 Furnish and install Hardie Plank fiber cement siding, Hardie Trim fascia and moulding and accessories were shown on drawings or as specified herein.

1.2.2 Coordinate this section with interfacing and adjoining work for proper sequence of installation.

1.2.3 Work in other sections affecting this work:

.1 Section 06101 – Rough Carpentry

.2 Section 07212 – Board Insulation

1.3 Quality Insurance

1.3.1 Submittals: submit shop drawings in accordance with Section 01330 – Submittal Procedures.

.1 Submit three (3) 75mm x 150mm pieces of Hardie Plank claddings in texture, colour, and widths indicated and specified herein.

.2 Submit copies of specifications, installation data and other pertinent manufacturer's literature.

1.4 Product Handling

1.4.1 Stack Hardie Plank claddings on edge or lay flat on a smooth, level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

1.5 Job Conditions

1.5.1 38 mm x 63 mm wood framing selected for minimal shrinkage and complying with local building codes, including the use of weather-resistive barriers and vapour barriers as indicated. Minimum 38mm face and straight, true of uniform dimensions and properly aligned

1.5.2 Install weather-resistive barrier and claddings to dry surfaces.

1.5.3 Repair any punctures or tears in the weather-resistive barrier prior to the installation of the siding.

1.5.4 Protect siding from other trades.

1.6 Warranty

1.6.1 James Hardie's limited product warranty against manufacturing defects in Hardi Plank lap siding for 50 years and Hardie Trim for 10 years.

1.6.2 Workmanship: application limited warranty for two (2) years.

2 PRODUCTS

2.1 Materials

2.1.1 Siding: Hardie Plank / Hardie Trim Fascia and Moulding or Canadian equivalent.

.1 Non-asbestos fiber-cement siding to comply with ASTM Standard Specification C1186 Grade II, Type A.

.2 Siding to meet the following building code compliance National Evaluation Report No. NER 405 (BOCA, ICBO, SBCCI); City of Los Angeles, Research Report No. 24862; Metro Dade County, Florida Acceptance No. 94-1234.04; US Department of Housing and Urban Development Materials Release 1263a; California DSA PS-019; and City of New York MEA 223-93-M. Non-asbestos fiber-cement siding to be non-combustible when tested in accordance with ASTM test method E136.

.3 Siding Type: Hardie Plank Lap Siding – Smooth

.4 Trim Type: Hardie Trim Boards – Smooth

.5 Colour: To be determined

2.1.2 Water Resistive Barrier: Hardie Wrap or Canadian equivalent

3 EXECUTION

3.1 Surface Conditions

3.1.1 Correct conditions detrimental to timely and proper completion of work.

3.2 Installation – Hardie Trim Fascia and Moulding

3.2.1 Install flashing around all wall openings.

3.2.2 Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 19 mm or full thickness or sheathing. Additional fasteners may be required to ensure adequate security.

3.2.3 Place fasteners no closer than 19 mm no further than 50 mm from side edge of trim board and no closer than 25 mm from end. Fasten maximum 406 mm on centre.

3.2.4 Maintain clearance between trim and adjacent finished grade.

3.2.5 Install single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten Hardie Trim board to Hardie Trim board.

3.2.6 Allow 3 mm gap between trim and siding.

3.2.7 Seal gap with high quality, paint-able caulk.

3.2.8 Shim frieze board as required to align with corner trim.

3.2.9 Install Hardie Trim fascia over structural subfascial.

3.3 Installation – Hardie Plank Lap Siding

3.3.1 Starting: Install a minimum 6 mm thick lath starter strip at the bottom course of the wall. Apply planks horizontally with minimum 30 mm wide laps at the top. The bottom edge of the first plank overlaps the starter strip.

3.3.2 Allow minimum 25 mm vertical clearance between roofing and bottom edge of siding.

3.3.3 Align vertical joints of the planks over framing members.

3.3.4 Maintain clearance between siding and adjacent finished grade.

3.3.5 Locate splices at least one stud cavity away from window and door openings.

3.3.6 Use off-stud metal joiner when vertical joints occur between framing members. Position metal joiner so that the bottom lip is resting on the solid course of planks. Fasten plank to the framing. Position and fasten abutting plank into place insuring that the lower edges of the two planks align. Locate metal joiner centrally behind the joint. Locate off-stud splices a minimum of two stud cavities from wall corners and stagger all subsequent course splices at minimum 610 mm intervals when located in the same wall cavity.

3.3.7 Wind Resistance: Where a specified level of wind resistance is required Hardie Plank lap siding is installed to framing members and secured with fasteners described in Table No. 2 in National Evaluation Service Report No. NER-405.

3.4 Finishing

3.4.1 Finish unprimed siding with minimum one coat high quality, alkali-resistant primer and one coat of either 100 percent acrylic or latex or oil based, exterior grade topcoat or two coats high quality, alkali-resistant, 100 percent acrylic or latex, exterior grade topcoat within 90 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

END OF SECTION

1 GENERAL

1.1 Section Includes

1.1.1 Aluminum soffits and trim.

1.1.2 Custom trim shapes made on project site.

1.2 Related Sections

1.2.1 Section 06101 – Rough Carpentry

1.2.2 Section 07270 – Self-Adhered Air Vapour Barrier Membrane

1.2.3 Section 07900 – Joint Sealers

1.3 References

1.3.1 CAN/CGSB-93.2-M91 – Prefinished Aluminum Siding, Soffits and Fascia for Residential Use

1.3.2 CAN/ULC-S114-05 – Test for Determination of Non-Combustibility in Building Materials

1.4 Submittals

1.4.1 Submit under provisions of Section 01330 - Submittal Procedures.

1.5 Delivery, Storage and Handling

1.5.1 Store products in manufacturer's unopened labelled packaging until ready for installation.

1.5.2 Store boxes on flat surface to maximum height recommended by manufacturer.

2 PRODUCTS

2.1 Materials

2.1.1 Soffit: Aluminum sheet, painted before forming.

.1 Colour: Selected by Consultant from manufacturer's full range

.2 Gloss: Low

.3 Thickness: 0.53mm min.

.4 Profile: 1606 Vented 76.1 cm2/m

.5 Length: As required

2.1.2 Fascia: Aluminum sheet, painted before forming.

.1 Colour: Selected by Consultant from manufacturer's full range

.2 Gloss: Low

.3 Thickness: 0.53 mm min.

.4 Profile: Reference drawings

.5 Length: As required.

2.1.3 Trim Accessories: Same material and finish as Soffit, made by Soffit manufacturer, provide the following styles:

.1 J-Channel Trim

.2 F-Channel Trim

.3 Starter Strips (standard) – Aluminum

.4 Drip Edge

.5 Other trims required for a complete installation.

.6 Colour: To be determined, to match soffit and fascia.

2.1.4 Aluminum sheet for custom trim shapes: Tension-levelled aluminum sheet coil, suitable for brake bending on site without cracking, minimum bend radius per manufacturer's recommendations.

.1 Colour: Selected by Consultant from manufacturer's full range

.2 Gloss: Low

.3 Thickness: 0.53 mm min.

.4 Length: As required

3 EXECUTION

3.1 Examination

3.1.1 Verify that surfaces on which products are to be installed are weathertight and ready for installation.

3.1.2 Do not begin installation until surfaces have been properly prepared, notify Consultant of unsatisfactory preparation before proceeding.

3.2 Installation

3.2.1 Use concealed fastenings, except where approved before installation.

3.2.2 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.

3.2.3 Lock end joints and caulk with sealant.

3.2.4 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.

3.2.5 Caulk flashing at reglet with sealant.

3.2.6 Install continuous starter strips, inside and outside corners, edgings, Soffit, drip and cap.

3.3 Cleaning

3.3.1 Clean direct from surface of installed products, using mild soap and water.

3.3.2 Upon completion of installation, remove from project site excess materials and debris caused by Soffit/trim installation.

3.4 Protection

3.4.1 Protect installed products until completion of project.

3.4.2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 This section describes the materials and procedures for sheet metal flashing and trim installed by all trades including work in relation to building envelop, all openings through walls floors and roofs.

Provide all articles, labour, materials, equipment and transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.

1.2 Related Sections

1.2.1 Section 03300 – Cast-in-Place Concrete

1.2.2 Section 04050 – Masonry Procedures

1.2.3 Section 04053 – Masonry Accessories

1.2.4 Section 06101 – Rough Carpentry

1.2.5 Section 06310 - Prefabricated Wood Roof Trusses

1.2.6 Section 07270 – Self-Adhered Air Vapour Barrier Membrane.

1.2.7 Section 07212 – Board Insulation.

1.2.8 Divisions 15 and 16 – Mechanical and Electrical as applicable.

1.3 References

1.3.1 The Aluminum Association Inc. (AAI)

.1 AAI-Aluminum Sheet Metal Work in Building Construction-2020.

.2 AAI DAF45-03(R2009), Designation System for Aluminum Finishes.

1.3.2 American Society for Testing and Materials (ASTM):

.1 ASTM A167-99(2009), Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 ASTM A240/A240M-20, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A606/A660M-18, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.

.4 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.6 ASTM A879/A879-12(2017) – Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

.7 ASTM B32-20 – Standard Specification for Solder Metal

.8 ASTM B370-12(2019), Standard Specification for Copper Sheet and Strip for Building Construction.

.9 ASTM D523-14(2018), Standard Test Method for Specular Gloss.

.10 ASTM D822/D822M-13(2018) – Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings

1.3.3 Canadian Roofing Contractors Association (CRCA)

.1 Roofing Specifications Manual 1997.

1.3.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.

.2 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.

1.3.5 Canadian Standards Association (CSA):

.1 CSA A123.3-05(R2015), Asphalt Saturated Organic Roofing Felt.

.2 AAMA/WDMA/CSA 101/I.S.2/A440-17, Standard/Specification for Windows, Doors, and Unit Skylights.

.3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.4 CSA A440S1-19 – Windows, Doors and Skylights

1.3.6 Green Seal Environmental Standards

.1 Standard GS-03-15, Anti-Corrosive Paints.

.2 Standard GS-11-15, Architectural Paints.

.3 Standard GS-36-13, Commercial Adhesives.

1.3.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 Quality Assurance

1.4.1 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

1.4.2 Pre-installation meetings: comply with Section 01120 - Coordination and Sequence of Construction. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:

.1 Owner;

.2 Engineer;

.3 All affected Subcontractors;

.4 Manufacturer’s Technical Representative.

.2 Coordinate with related specification listed in section 1.3 - Related Specification Sections

.3 Verify project requirements, including mock-up requirements.

.4 Verify substrate conditions.

.5 Co-ordinate products, installation methods and techniques.

.6 Sequence work of related sections.

.7 Co-ordinate with other building sub-trades to ensure proper installation and site preparation.

.8 Review manufacturer's installation instructions.

.9 Review warranty requirements.

1.5 Submittals

1.5.1 Complete submittals in accordance with Specification Section 01330

1.5.2 Product Data:

.1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Health and Safety Requirements and 01400 - Environmental Protection.

1.5.3 Samples

.1 Submit shop drawings in accordance with Section 01330 – Submittal Procedures.

.2 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.

1.5.4 Alternatives

.1 Submit requests for alternatives in accordance with Section 01200 – Alternatives.

1.5.5 Quality assurance submittals:

.1 Submit following in accordance with Section 01450 - Quality Control.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.3 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work.

1.6 Delivery Storage and Handling

1.6.1 Refer to Specification Section 01610 - Basic Product Requirements.

1.6.2 Deliver, store and handle materials in accordance to manufacturer’s recommendations.

1.6.3 Flashing will be stored to avoid creasing, buckling, scratching, or any other possible damage.

2 PRODUCTS

2.1 Sheet Metal Materials

2.1.1 Zinc Coated Steel Sheet: .50 mm thickness, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.

2.2 Pre-finished Steel Sheet

2.2.1 Pre-finished steel sheet with factory applied Colourite HMP, 8000+ Series, or approved equivalent system.

.1 Class: F1S.

.2 Colour: to be selected by Consultant from manufacturer’s full range.

.3 Specular gloss: 30 units ±5 in accordance with ASTM D523.

.4 Coating thickness: not less than 25 ±5 micrometers.

.5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20 percent to ASTM D822 as follows:

.1 Outdoor exposure period: 2500 hours.

.2 Humidity resistance exposure period: 5000 hours.

2.3 Aluminum Sheet

2.3.1 Alcan Industrial Building Sheet, Alloy 1100 H14, Duranar 22 micron thick DFT minimum, coated after forming. Finish sheet after forming. Colour to be selected by Consultant from manufacturer's full range..

2.3.2 Coping flashings, cap flashings, counter flashings: 1.0 mm thick aluminum sheet.

2.3.3 Counter flashings in other locations: 0.8 mm thick aluminum sheet.

2.3.4 Locking strip: 1.63 mm thick aluminum sheet nominal thickness.

2.3.5 Accessories: As required, compatible with materials used.

2.3.6 Fastenings: Same finish as sheet being fastened, sized to suit site conditions, stainless steel

2.3.7 Sealant: CAN/CGSB-19.13-M, one component DC795 by Dow Corning Inc. Primer as recommended by sealant manufacturer. Colour to match flashing finish colour.

2.3.8 Backpaint: ASTM D1187 Bituminous Paint.

2.4 Accessories

2.4.1 Isolating coating: alkali resistant bituminous paint.

2.4.2 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.

2.4.3 Sealants: to Section 07900 – Joint Sealers.

2.4.4 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness: same as sheet metal being secured.

2.4.5 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.

2.4.6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

2.4.7 Solder: to ASTM B32.

2.4.8 Flux: rosin, cut hydrochloric acid or commercial preparation suitable for materials to be soldered.

2.4.9 Touch-up paint: as recommended by pre-finished material manufacturer.

2.5 Fabrication

2.5.1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.

2.5.2 Form pieces in 2400 mm maximum lengths.

.1 Make allowance for expansion at joints.

2.5.3 Hem exposed edges on underside 12 mm.

.1 Mitre and seal corners with sealant.

2.5.4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

2.5.5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.6 Metal Flashings

2.6.1 Form flashings and copings to profiles indicated of .50 mm thick pre-finished steel.

2.7 Reglets and Cap Flashings

2.7.1 Form recessed reglets metal cap flashing of .50 mm thick steel sheet metal to be built-in masonry work for base flashings as detailed. Provide slotted fixing holes and steel/plastic washer fasteners. Cover face and ends with plastic tape.

2.8 Eaves Troughs and Downpipes

2.8.1 Form eaves troughs and downpipes from .50 mm thick pre-finished steel sheet metal.

2.8.2 Size 1 trough 125 mm wide @ 0.5 percent slope, downpipes 100 mm wide.

2.8.3 Provide goosenecks, outlets, strainer baskets and necessary fastenings.

2.8.4 Form 600 mm x 600 mm splash pans from .91 mm thick galvanized steel sheet metal.

3 EXECUTION

3.1 Installation

3.1.1 Install sheet metal work in accordance with CRCA FL series details, as detailed.

3.1.2 Flashing to be installed with a minimum slope of 1:10 unless indicated otherwise on drawings.

3.1.3 Use concealed fastenings, unless exposed fastenersare approved by Consultant before installation.

3.1.4 Provide underlay under sheet metal.

.1 Secure in place and lap joints 100 mm.

3.1.5 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.

.1 Flash joints using S-lock forming tight fit over hook strips, as detailed.

3.1.6 Lock end joints and caulk with sealant.

3.1.7 Install surface mounted reglets true and level, and caulk top of reglet with sealant.

3.1.8 Insert metal flashing into reglets to form weather tight junction.

3.1.9 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.

3.1.10 Caulk flashing where required and at reglet with sealant.

3.1.11 Install pans, where shown around items projecting through roof membrane.

3.2 Eaves Troughs and Downpipes

3.2.1 Install eaves troughs and secure to building at 750 mm on centre with eaves trough spikes through spacer ferrules.

.1 Slope eaves troughs to downpipes as indicated.

.2 Solder seal joints watertight.

3.2.2 Install downpipes and provide goosenecks back to wall.

.1 Secure downpipes to wall with straps at 1800 mm on centre; minimum two (2) straps per downpipe.

.2 Connect downpipes to drainage system and seal joint with plastic cement.

3.2.3 Install splash pans at all downspouts, unless noted otherwise.

3.3 CLEANING

3.3.1 Clean in accordance with Section 01740 - Cleaning.

3.3.2 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

3.3.3 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

3.3.4 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

.2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.3.5 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.3.6 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

1 GENERAL

1.1 General Requirements

1.1.1 Comply with requirements of Division 1 – General Requirements.

1.2 Intent

1.2.1 Include in work of this section all fire stopping required except for fire stopping and smoke seals within mechanical assemblies (i.e., inside ducts, dampers) and electrical assemblies (i.e., inside bus ducts) which shall be provided as part of work of Divisions 15 and 16 respectively. Fire stopping and smoke seals around outside of such mechanical and electrical assemblies, where they penetrate fire rated separations, shall be part of the work of this section.

1.2.2 Fire stop and seal (draft-tight) gaps, control joints, expansion joints and penetrations in fire rated assemblies, including assemblies with a zero rating, against passage of fire, smoke, gasses, fire fighter's hose stream and, where designated, passage of liquids. Smoke seal at angle support at fire dampers.

1.3 Related Sections

1.3.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1	Section 03300	Cast-in-Place Concrete
.2	Section 04050	Masonry Procedures
.3	Section 06101	Rough Carpentry
.4	Section 07212	Board Insulation
.5	Section 07270	Self-Adhered Air Vapour Barrier Membrane
.6	Division 15	Mechanical
.7	Division 16	Electrical

1.4 References

1.4.1 ASTM E2174-20a - Standard Practice for On-Site Inspection of Installed Fire Stops

1.4.2 CAN/ULC S115–2018- Standard Method of Fire Tests of Firestop System

1.4.3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory.

1.4.4 Test Requirements: UL 2079, "Tests for Fire Resistance of Building Joint Systems". These test requirements provide more guidelines for testing moving joints than that given in CAN4-S115-

M. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their “Products Certified for Canada (cUL) Directory.

1.4.5 Canada Green Building Council (CaGBC). LEED Canada V4.0- Building Design and Construction, Interior Design + Construction (ID+C)

Health Canada/ Workplace Hazardous Material Information System (WHMIS).

1.4.6 Inspection Requirements: ASTM E 2174, “Standard Practice for On-site Inspection of Installed Fire Stops.”, and ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

1.4.7 CAN/ULC-S102:2018, Standard Test Method for Surface Burning Characteristics of Building Materials and CAN/ULC-S101 Fire Endurance Tests of Building Construction and Materials.

1.4.8 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.

1.4.9 All major building codes: National Building Code (NBC), Ontario Building Code (OBC)

1.5 Definitions and Abbreviations

1.5.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

1.5.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

1.5.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

1.5.4 Tightly Fitted; (ref: OBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of non-combustible construction or have "0" annular space in buildings of combustible construction.

1.5.5 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.6 Quality Assurance

1.6.1 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years experience in installation of fire stopping materials.

1.6.2 Authorities having Jurisdiction:

1.6.3 Provide certificate of compliance from authority having jurisdiction indicating approval.

1.6.4 The contractor is expected to provide details as required by the documents as well as by the Municipal Building Inspector.

.1 For those firestop applications that exist for which no ULC or CUL tested system is available through the manufacturer, a manufacturer's engineering judgment derived from similar ULC or CUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation.

Relationship to other trades:Sequence Work to permit fire stopping materials to be installed after adjacent and surrounding work is completed, and before gypsum wallboard track, fireproofing, and mechanical pipe insulation are installed.

1.6.5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council

1.7 Submittals

1.7.1 Complete submittals in accordance with Specification Section 01330.

1.7.2 Product Data:

.1 Prior to start of work, submit list of proposed fire stopping and smoke seal materials, together with suitable documentation to verify that specified requirements will be met. Provide the following information as applicable to this project.

.1 ULC, UL or Intertek assembly number certification.

.2 Required temperature rise and flame rating.

.3 Hose stream rating (where applicable).

.4 Thickness.

.5 Manufactures approved standard detail for each installation method.

.6 Material of fire stopping and smoke seals, primers, reinforcements, damming materials, reinforcements and anchorages/fastenings.

.7 Size of opening.

.8 Adjacent material.

.2 Submit WHMIS and MSDS - Material Safety Data Sheets

1.7.3 Shop Drawings:

.1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.

.2 Indicate the ULC, UL or Intertek system number, the required temperature and flame rating, thickness, installation methods and materials of fire stopping and smoke seals, damming materials.

.3 Construction details should accurately reflect actual job conditions.

1.7.4 Samples:

.1 Upon Engineer's request, submit three duplicate 300 x 300 mm samples showing actual fire stop and smoke seal material proposed for project.

1.7.5 Quality assurance submittals:

.1 Submit following in accordance with Section 01450 - Quality Control.

.2 Test reports: in accordance with CAN-ULC-S101 for fire endurance, CAN-ULC-S102 for surface burning characteristics and CAN/ULC-S115 for firestop and construction joint systems.

.3 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

.6 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work.

1.7.6 Close-Out Submittal

.1 In accordance with Section 01780 –Closeout Submittals and in addition:

.1 Submit a set of architectural plans, prepared after receipt of Mechanical and Electrical record drawings, showing locations of all fire stop seals on each floor.

.2 Prepare and submit a corresponding typewritten listing, indicating penetration, sizing, location on plan and applicable ULC listing card number.

1.8 Delivery, Storage and Handling

1.8.1 Deliver materials to site in manufacturer's sealed and labelled containers.

1.8.2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

1.8.3 Store materials in protected location prior to use, in accordance with manufacturer's directions.

1.8.4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

1.9 Environmental Conditions

1.9.1 Conform to manufacturer's recommended temperatures, relative humidity and substrate moisture content for storage, mixing, application and curing of fire stopping materials.

2 PRODUCTS

2.1 Design Criteria

2.1.1 Fire stopping and smoke seal systems shall be:

.1 Tested in accordance with CAN/ULC S115.

.2 Listed by ULC, UL or Intertek or other fire testing agency approved by jurisdictional authorities.

.3 Capable of providing fire resistance rating not less than that required by surrounding assembly.

.4 Comply with F, T and H rating required.

2.1.2 Fire stopping and smoke seals for vertical fire separations shall meet ULC designation PJ, JF and HW as required for respective location.

2.1.3 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

2.1.4 For combustible pipe penetrations through a Fire Separation provide a firestop system with a "F" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

2.1.5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council

2.2 Approved Manufacturers

2.2.1 HILTI, 2360 Meadowpine Boulevard, Mississauga, Ontario, Canada, L5N 6S2, Phone: (416) 434-8939, e-mail: tyrone.subhan@hilti.com, URL: www.hilti.ca.

2.2.2 3M Canada, 300 Tartan Dr, London, Ontario, Canada, N5V 4M9, Phone: (800)-265-1840, e-mail: maheaps@mmm.com, URL: www.3mcanada.ca/3M/en_CA/company-ca/.

2.2.3 Tremco, 220 Wicksteed Avenue, Toronto, Ontario, Canada, M5H 1G7, Phone: (800) 363-3213, e-mail: TORSCS@tremcoinc.com, URL: www.tremcosealants.com.

2.2.4 Equivalent products may be submitted for Engineer's approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.3 Materials

2.3.1 Fire stopping and smoke seal materials.

.1 Provide materials which are:

.1 PCB and asbestos-free.

.2 Easily identifiable colour, except where used in exposed location.

.3 Suitable for intended application.

.4 Compatible with adjacent materials.

.5 Flexible enough to allow for pipe vibration in through penetration application.

.6 Flexible enough to satisfy the movement in construction joint applications.

.2 Sealant type materials shall be non-sagging for vertical surfaces and self-levelling for level floors.

2.3.2 Primer: as recommended by fire stopping material manufacturer for specific substrate and use.

2.3.3 Damming and back-up materials, support and anchoring devices: non-combustible, in accordance with tested assembly and as recommended by manufacturer.

2.3.4 For penetrations by non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following materials are acceptable:

.1 CFS-S SIL GG Hilti Firestop Silicone Sealant Gun Grade

.2 CFS-S SIL SL Hilti Firestop Silicone Sealant Self Leveling

.3 Hilti FS ONE High Performance Intumescent Firestop Sealant

.4 CP 620/ CP 660 Hilti Fire Foam

.5 3M Fire Barrier Silicone Sealant 1000 NS or 1003 SL

.6 3M Fire Barrier Sealant FD 150+

.7 3M Fire Barrier Sealant CP 25WB+

.8 Tremco TREMstop Fyre-Sil Sealant

2.3.5 For fire rated construction joints, expansion joints, and other gaps, the following materials are acceptable:

.1 Hilti CFS-S SIL GG Hilti Firestop Silicone Sealant Gun Grade

.2 Hilti CFS-S SIL SL Hilti Firestop Silicone Sealant Self Leveling

.3 Hilti CP 606 Flexible Firestop Sealant.

.4 Hilti CFS-SP WB Firestop Joint Spray

.5 Hilti CFS-TTS Top Track Seal

.6 3M Fire Barrier Sealant FD 150+

.7 3M FireDam Spray 200

.8 Tremco TREMstop Fyre-Sil Sealant

2.3.6 For penetrations by combustible items (penetrants consumed by high heat aflame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe (closed piping systems) the following materials are acceptable:

.1 Hilti FS-ONE Intumescent Firestop Sealant

.2 Hilti CP 643N Firestop Collar

.3 Hilti CP 648E/648S Wrap Strips

.4 3M Fire Barrier CP25 WB+

.5 3M Fire Barrier FS 195+ Wrap/Strip

.6 Tremco TREMstop WS Intumescent Wrap Strip or Tremstop IA+

2.3.7 For firestopping at Electrical Vboxes and Utility Outlets.

.1 Hilti Firestop Box Insert

.2 Hilti CP 617 Firestop Putty Pad

.3 3M Fire Barrier Mouldable Putty Pads MPP+

.4 Tremco TREMstop MP Moldable Putty Pad

2.3.8 Pre-formed firestop devices for use with non-combustible and combustible pipes (closed and open systems), conduit and/or cable bundles penetrating concrete floors and/or gypsum walls, the following products are acceptable:

.1 Hilti Tub Box Kit (CP 681) for use with tub installations.

.2 Hilti Cast-In Place Firestop Device (CP 680-PX) for use with XFR pipe

.3 Hilti Cast-In Place Firestop Device (CP 680-M) for use with noncombustible penetrants.

.4 Hilti Speed Sleeve (CP 653) for use with cable penetrations.

.5 Hilti Firestop Drop-In Device (CFS-DID) for use with noncombustible and combustible penetrants.

2.3.9 .6 Hilti Firestop Block (CFS-BL)Non-curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:

.1 Hilti CP 618 Firestop Putty Stick

.2 Hilti CFS-PL Firestop Plug

2.3.10 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls, the following products are acceptable:

.1 Hilti Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.

.2 Hilti Firestop Cable Collar (CFS-CC)

.3 Hilti Firestop Sleeve (CFS-SL SK)

.4 Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles.

.5 Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices.

.6 Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations.

2.3.11 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:

.1 Hilti CFS-BL Firestop Block (for walls and floors)

.2 Hilti CFS-PL Firestop Plug (for walls and floors)

.3 Hilti CP 680 Cast-In Place Firestop Device (for floors only)

2.3.12 All other penetrations that do not fall under one of the categories listed in previous sections, and where a standard detail or product will not resolve the fire separation penetration, the contractor is responsible for providing a manufactures approved proposed engineered solution for review and approval by the engineer.

.1 The proposed engineer solution must me signed and stamped by and engineer licensed and insured to practice in the province of Ontario, Canada.

2.4 Mixing

2.4.1 Mix materials at correct temperatures and in accordance with manufacturer's directions.

3 EXECUTION

3.1 Preparation

3.1.1 Remove combustible material, loose material, or any other substance that may be detrimental to bond from edges of penetration. Clean, prime or otherwise prepare substrate material to manufacturer's recommendation.

3.1.2 Do not apply fire stop material to surfaces previously painted or treated with sealer, curing compound, water repellent to other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

3.1.3 Verify openings, dimensions and surfaces conform to fire and smoke seal assembly.

3.1.4 Protect adjacent surfaces with manufacturer's directions.

3.1.5 Prime surfaces in accordance with manufacturer's directions.

3.1.6 Remove insulation from area of insulated pipe and duct where such pipes or ducts penetrate fire separation unless ULC certified assembly permits such insulation to remain within assembly.

3.1.7 Provide temporary damming, forming, packing and bracing materials necessary to contain fire stopping. Upon completion, remove forming and damming materials not required to remain as part of system.

3.1.8 Examine sizes, anticipated movement and conditions of opening and penetration to establish correct system and depth of back-up materials and of fire stopping material required.

3.1.9 Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers, and clips.

3.2 Coordination

3.2.1 Coordinate construction of openings, penetrations and construction joints to ensure that the fire stop systems are installed according to specified requirements.

3.2.2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems. Coordinate construction and sizing of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

3.2.3 Coordinate fire stopping installation with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems and to protect the system from work done by other trades.

3.3 Installation

3.3.1 Seal penetrations through and gaps in fire rated separations in accordance with ULC, UL or Intertek listing for tested system selected.

3.3.2 Apply fire stopping materials in accordance with manufacturer's instruction and tested designs. Apply with sufficient pressure to properly fill and seal openings to ensure continuity and integrity of fire separation. Tool or trowel exposed surfaces as required.

3.3.3 Remove excess compound promptly as work progresses and upon completion.

3.3.4 Do not cover materials until full cure has taken place.

3.3.5 Provide fire stopping and smoke seal systems at following locations, without being limited to:

.1 At all openings, voids and penetrations through all floor slabs except openings within shafts constructed with a fire resistance rating and slabs on granular fill.

.2 At all openings, voids, control joints and penetrations through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.

.3 At all openings, voids, penetrations installed for future use through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.

.4 Around mechanical and electrical assemblies penetrating fire rated assemblies.

.5 Between perimeter of all floor and roof slabs and exterior wall construction.

.6 Between tops of all fire rated walls and partitions and underside of floor or roof slabs.

.7 At building expansion joints.

3.3.6 Curing: cure materials in accordance with manufacturer's directions.

3.3.7 Protect materials from damage on surfaces subjected to traffic.

3.4 Field Quality Control

3.4.1 Upon Engineer's request, manufacturer's representative shall inspect work of this section and confirm in writing that it complies with specified requirements. .5 Manufacturer's Field Services: The manufacturer's representative to be present during the first installation of every first firestop system. The manufacturer's technical representative to provide periodic walk-through. After every site visit the manufacturer's technical representative to submit site reports to indicate application reviewed, location and installer. Contractor to submit site reports by manufacturer to consultant within one week of each visit

3.4.2 Request Engineer's review of installed systems before they are covered by other work.

3.4.3 Owner may arrange and pay separately for inspection and testing of work of this section by independent agency as directed by Engineer.

3.4.4 Inspection of through-penetration fire stopping shall be performed in accordance with ASTM E2174 or other recognized standard.

END OF SECTION

1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Labour, Products, equipment, and services necessary for sealants Work in accordance with Contract Documents.

1.2 Related Specification Sections

1.2.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 01330 Submittals.

.2 Section 01450 Quality Control.

.3 Section 03300 Cast-in-place Concrete

.4 Section 04050 Masonry Procedures.

.5 Section 07840 Fire Stopping.

1.2.2 Refer to other sections for other caulking and sealants

1.3 Code and Regulatory Requirements

1.3.1 All products shall conform to the following standards and regulations:

.1 ASTM International Inc.

.1 ASTM C510-16, Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.

.2 ASTM C834-17 – Specification for Latex Sealants

.3 ASTM C919-19, Standard Practice for Use of Sealants in Acoustical Applications.

.4 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.

.5 ASTM C1021-08(2019), Standard Practice for Laboratories Engaged in Testing of Building Sealants.

.6 ASTM C1184-18e1, Standard Specification for Structural Silicone Sealants.

.7 ASTM C1193-16, Standard Guide for Use of Joint Sealants.

.8 ASTM C1248-18, Standard Test Method for Staining of Porous Substrate by Joint Sealants.

.9 ASTM C1311-14 – Standard Specification for Solvent Release Sealants

.10 ASTM C1330-18, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.

.11 ASTM D5893/D5893M-16, Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).

.2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).

.4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.

.5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

.3 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.4 General Services Administration (GSA) - Federal Specifications (FS)

.1 FS-SS-S-200-E(2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.4 SUBMITTALS

1.4.1 Submit in accordance with Section 01330.

1.4.2 Shop Drawing(s):

.1 Submit in accordance with Section 01330 indicating:

.2 Provide a summary chart listing all submitted products, applicable accessories, proposed application type, and sealant location. Include labels as outlined in this specification.

.3 Sealant type, composition, recommendations or directions for surface preparation, material preparation, and material installation.

1.4.3 Quality Assurance Submittal(s):

.1 Submit pre-installation meeting reports.

.2 Submit field quality control inspection and test report results.

1.5 QUALITY ASSURANCE

1.5.1 Applicator qualifications:

.1 Execute Work by applicators trained and approved by the manufacturer and having 5 years proven experience.

1.5.2 Mock-up:

.1 Construct mock-up for each type of sealant to show location, size, shape, colours, and depth of joints complete with bond breaker, joint backing, primer, and sealant. Accepted mock-up may become part of finished Work.

.2 Remove mock-ups that do not form part of Work from Site during final cleanup, or when directed by Owner.

.3 Allow 24 hoursfor Owner to review mock-up before proceeding with sealant Work.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Deliver materials to the Site in their original, unopened containers, with Product labels intact.

.1 Product labels: Identify the manufacturer's name, brand name, date of manufacture, grade, and type, application directions, and expiry date or shelf life.

1.6.2 Store flammable materials in safe containers to eliminate fire hazards.

1.6.3 Store materials in accordance with manufacturer’s recommendations.

1.6.4 Maintain materials to prevent deterioration or contamination by foreign materials.

1.6.5 Keep materials dry and free from snow, ice and frost.

1.7 SITE CONDITIONS

1.7.1 Do not proceed with installation of joint sealants when:

.1 Ambient air temperatures are less than 5°C.

.2 Joint substrates and recesses are wet or damp.

.3 Where contaminates which may interfere with adhesion have not been removed from joint substrates.

.4 Site conditions do not meet manufacturer's recommendations.

2 PRODUCTS

2.1 MATERIALS - SEALANTS

2.1.1 Type A:

.1 Single component, non-sag, non-paintable, silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 25, and non-staining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 As selected by Engineer. Allow for more than one colour, for selection from the manufacturer’s full colour range, and for custom colours.

.3 Manufacturer’s Products:

.1 Dow Corning Contractors Weatherproofing Sealant (CWS) by Dow Corning Corp.

.2 Tremsil 400 by Tremco (Canada) Ltd., division of RPM Company.

.3 Sikasil-N plus by Sika Canada Inc.

.4 GE SWS by Momentive Performance Materials.

.5 Pecora PCS by Pecora Corporation.

2.1.2 Type B:

.1 Silicone joint sealant, in accordance with ASTM D5893/D5893M and non-staining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 As selected by Engineer. Allow for more than one colour, for selection from the manufacturer’s full colour range, and for custom colours.

.3 Manufacturer’s Products:

.1 Dow Corning Contractors Concrete Sealant (CCS) by Dow Corning Corp.

.2 Spectrum 900 SL by Tremco (Canada) Ltd., division of RPM Company.

.3 SikaSil 728 SL by Sika Canada Inc.

.4 Tosseal 817 by Momentive Performance Materials.

.5 300SL by Pecora Corporation.

2.1.3 Type F:

.1 Low dirt pick-up, silicone joint sealant, in accordance with ASTM C920, Type S, Grade NS, minimum Class 50, and non-staining when tested in accordance with ASTM C510 or ASTM C1248.

.2 Colour:

.1 As selected by Engineer. Allow for more than one colour, for selection from the manufacturer's full colour range, and for custom colours.

.3 Manufacturer's Products:

.1 Dow Corning 756 SMS Building Sealant by Dow Corning Corp.

.2 Spectrem 3 by Tremco (Canada) Ltd., division of RPM Company.

.3 SikaSil WS-295 by Sika Canada Inc.

.4 GE SCS9000 Silpruf NB by Momentive Performance Materials.

.5 Pecora 864NST by Pecora Corporation.

2.2 ACCESSORIES

2.2.1 Primers:

.1 Type recommended by sealant manufacturer for substrate, to promote adhesion and to prevent staining of adjacent surfaces for conditions encountered.

2.2.2 Joint backing:

.1 Extruded, round, solid section, skinned surface, closed cell, soft polyethylene foam gasket stock, compatible with primer and sealant materials.

.2 30% to 50% oversized.

.3 Shore A hardness of 20, tensile strength 140 kPa to 200 kPa, in accordance with ASTM C1330.

.4 Bond breaker type surface.

2.2.3 Bond breaker tape:

.1 Polyethylene tape or other plastic tape recommended by sealant manufacturer to prevent sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.

.2 Provide self-adhesive, pressure sensitive tape where applicable.

.3 Do not use material impregnated with oil, bitumen, non-curing polymer or similar deleterious material.

2.2.4 Cleaning agents:

.1 Recommended by sealant manufacturer.

.2 Free of oily residues or other substances capable of staining or harming joint substrates and adjacent surfaces.

2.2.5 Masking tape:

.1 Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify substrate conditions and dimensions of previously installed Work upon which this Section depends.

3.1.2 Report defects to Owner. Commencement of Work means acceptance of existing conditions.

3.2 PREPARATION

3.2.1 Ensure joint sealants, primers, joint backing, bond breaker and cleaning agents are compatible with one another and with joint substrates.

3.2.2 Prior to the commencement of sealant application, arrange for sealant manufacturer's representative to perform a site adhesion test on each substrate type to which each sealant will be applied.

3.2.3 Ensure surface preparation and primer recommendation is compatible with each substrate type.

3.2.4 Ensure masonry and concrete substrates have cured a minimum of 28 Days prior to proceeding with sealant Work.

3.2.5 Clean joints to receive sealants in accordance with the manufacturer's recommendations and as specified in this Section.

3.2.6 Remove foreign matter from joint substrates that could interfere with adhesion of joint sealant, including surface dirt, dust, old joint sealants, oil, grease, waterproofing, water repellents, water, sealers, curing compounds, mortar, loose material, frost, and other substances detrimental to sealant’s performance.

3.2.7 Remove paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer.

3.2.8 Remove lacquer or other protective coatings from metal surfaces, without damaging metal finish, using oil-free solvents.

3.2.9 Remove laitance and form-release agents from concrete.

3.2.10 Remove rust, mill scale, and coatings from ferrous metals.

3.2.11 Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.

.1 Remove loose particles remaining after porous joint cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

.2 Porous joint substrates include, but are not limited to the following:

.1 Cast-in-place concrete.

.2 Unit masonry.

.3 Unglazed surfaces of ceramic tile.

3.2.12 Clean nonporous joint substrate surfaces with cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

.1 Wire brush, grinding, or sand blasting methods may be used on ferrous metals.

.2 Non-porous joint substrates include, but are not limited to the following:

.1 Metal.

.2 Glass.

.3 Porcelain enamel.

.4 Glazed surfaces of ceramic tile.

3.2.13 Joint priming:

.1 Prime joint substrates and apply primer in accordance with sealant manufacturer's recommendations.

.2 Confine primers to areas of joint-sealant bond.

.3 Spillage or migration to adjoining surfaces is not permitted.

3.2.14 Masking tape:

.1 Prior to performing Work, use masking tape of other means to protect adjacent exposed surfaces from damage including, but not limited to smearing and staining.

.2 Remove protection immediately upon completion and clean adjacent, exposed surfaces of any compound deposited upon such surfaces.

3.3 INSTALLATION

3.3.1 Perform Work in accordance with manufacturer’s recommendations for Products and applications indicated, unless more stringent requirements apply.

3.3.2 Use Products without additives or adulteration. Use one manufacturer's Product for each location in accordance with Article 2.

3.3.3 Perform Work in accordance with ASTM C1193.

3.3.4 Joint backing:

.1 Install joint backing to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

.1 Depth of recess: Maintain 2:1 joint width to depth ratio, up to a maximum of 13 mm, and not less than 6 mm at centre of joint.

.2 Where recess is less than specified depth, cut back surface of recess to specified depth.

.2 Do not leave gaps between ends of joint backings.

.3 Do not stretch, twist, puncture, or tear joint backings.

.4 Remove absorbent joint backings that have become wet before sealant application, and replace with dry materials.

.5 Support joint backing on horizontal surfaces against vertical movement which might result from pedestrian or vehicular traffic loads.

3.3.5 Install bond breaker tape between sealant and back of joints where joint backing is not used.

3.3.6 Apply sealant immediately after adjoining Work is in condition to receive sealant Work and as follows:

.1 Apply sealant in a continuous bead using gun with correctly sized nozzle. Use sufficient pressure to completely fill joint recess.

.2 Ensure sealant has full, direct uniform contact with, and adhesion to, side surfaces of recess. Superficial pointing with skin bead is not acceptable.

3.3.7 Tooling:

.1 Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified to form smooth, uniform sealant bead, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains, or other defects.

.2 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.

.3 At recesses in flush surfaces, finish sealant with concave face and flush with face of material at each side.

3.3.8 Immediately remove excess sealant and droppings.

3.3.9 Ensure sealant bead is uniform in colour.

3.3.10 Cure in accordance with the sealant manufacturer's recommendations. Do not cover up sealants until proper curing has taken place.

3.3.11 Remove defective sealant and reapply.

3.4 FIELD QUALITY CONTROL

3.4.1 Retain an independent inspection and testing agency to conduct field inspection and testing of sealant.

3.4.2 Prepare and submit inspection reports to Owner.

3.5 CLEANING

3.5.1 Clean surfaces adjacent to joints. Immediately remove sealant smears or other soiling resulting from application of sealants.

3.5.2 Remove masking tape and other residue.

3.5.3 Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.

3.6 PROTECTION

3.6.1 Protect joint sealants:

.1 During and after curing period from contact with contaminating substrates.

.2 From damages by construction operations or other causes.

3.6.2 If damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated sealants immediately.

3.7 Sealant locations schedule

Sealant Locations Schedule

Type A	Above grade level, vertical applications
- General perimeter caulking (window, doors and frames, louver frames, shelf angles, thresholds, bedding of mullions, precast and tilt-up panels). - Vertical expansion, control, lap joints application. - Painted metals. - Mullion joints. - Interior partition head to structure above. - Interior metal frames joints. - Exterior metal flashing. - Locations not indicated on Contract Drawings and required sealant for Work.	

Type B	Above grade level, horizontal applications
- Horizontal expansion joints. - Saw cut horizontal joints. - Precast slab horizontal joints. - Horizontal expansion and control joints in parking garages, plazas, terraces, decks, floors, and sidewalks.	

Type F	Above grade level, horizontal and vertical applications
- Required non-staining to building materials. - Expansion and control joints in concrete panels, non-staining to building materials is required. - Metal curtain wall. - Porous surface including marble, granite, stone, and concrete, where non-	

staining to building materials is required.

- EIFS.
- Exterior and interior metal panels.
- Masonry, where non-staining to building materials is required.

END OF SECTION

DIVISION 8 – DOORS AND WINDOWS

Section No.	Title
08110	Steel Doors and Frames
08200	FRP Doors and Frames
08710	Door Hardware
08800	Fire-Rated and Safety Glass

1 GENERAL

1.1 Intent

1.1.1 This section describes the materials and procedures for Steel Frame Products installed by trades in relation to building veneers and all openings through walls that will facilitate a door assembly.

1.2 Scope of Work

1.2.1 Work supplied under this section includes Steel Frame Products including frames, transom frames, side light and window assemblies, fire labelled and non-labelled, accessories as indicated on drawings and door schedule.

1.2.2 Steel doors, swing type, flush, glazed or louvered, fire labelled, with or without temperature rise ratings and rated louvers, and non-labelled as indicated on drawings and door schedule

1.3 Related Specifications Sections

1.3.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 07840 Fire Stopping

.2 Section 07900 Joint Sealers

.3 Section 08710 Door Hardware

.4 Division 9 Finishes

1.4 Code and Regulatory Requirements

1.4.1 All products shall conform to the following standards and regulations:

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A568/A568M-15 – General Requirements for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled

.2 ASTM A653/A653M-15e1 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.3 ASTM B29-14 - Specification for Refined Lead

.4 ASTM B749-14 - Specification for Lead and Lead Alloy Strip, Sheet and Plate Products

.5 ASTM C665-12 – Standard Specification for Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

.2 Master Painters Institute (MPI):

.1 MPI #18 – Primer, Zinc Rich, Organic.

.3 Canadian Standards Association (CSA):

.1 CAN/CSA A440.4-07 (R2016) – Window, Door and Skylight Installation

.2 CAN/CSA G40.20-13/G40.21-13 - Structural Quality Steels

.3 CSA W59-13 - Welded Steel Construction Metal Arc Welding

.4 CAN/CSA A440.2-14/A440.3-14 – Fenestration Energy Performance / User Guide to CSA A440.2-09, Fenestration Energy Performance

.4 Canadian Steel Door Manufacturers' Association (CSDMA):

.1 CSDMA - Specifications for Commercial Steel Doors and Frames, 2006

.2 CSDMA - Recommended Selection and Usage Guide for Commercial Steel Doors, 2009

1.5 Quality Assurance

1.5.1 Metal door and frame manufacturer shall be a member in good standing of the Canadian Steel Door and Frame Manufacturers' Association.

1.5.2 Supply material manufactured to standards of Canadian Steel Door and Frame Manufacturer's Association "Canadian Manufacturing Standards for Steel Doors and Frames" – 1/78.

1.5.3 Defective materials or quality of work whenever found at any time prior to final acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight and error. Remove and replace defective materials, and the work of other trades affected by this replacement, at no additional cost.

1.6 Submittals

1.6.1 General: Complete submittals in accordance with Specification Section 01330.

1.6.2 Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods.

1.6.3 Samples: Submit in accordance with Section 01330 – Submittal Procedures.

1.6.4 Shop drawings: Submit in accordance with Section 01330 – Submittal Procedures.

.1 Details of each opening, showing elevations, glazing, louvered, frame profiles and identifying location of different finishes, if any.

.2 Indicate each type of door and frame, material, steel core thickness, mortises, reinforcements, stops, location of anchors, location of exposed fasteners, arrangement of hardware and fire rating.

.3 Include schedule identifying each unit with door marks and numbers relating to numbering on drawings and door schedule.

1.6.5 Colour: to be selected by Engineer during shop drawings.

1.1.1 Closeout Submittals:

.1 Submit in accordance with Section 01780 – Closeout Submittals.

.2 Provide final certified shop drawings for incorporation into manual specified in Section 01810 – Testing and Commissioning.

1.6.6 Warranty: Submit manufacturer's standard warranty.

1.7 Delivery Storage and Handling

1.7.1 Shipping and Delivery

.1 Doors and frames shall be shipped pre-hung in containers such as to prevent damage to finish.

.2 Doors and frames shall be delivered by common carrier with shipping containers intact and door manufacturer's name clearly identifiable. Manufacturers must be notified if shipping containers arrive damaged. Acceptance of damaged shipment may void warranty.

.3 Containers shall be labelled clearly identifying opening door mark.

.4 Co-ordinate delivery schedule of materials with the suppliers.

1.7.2 Handling and Storage

.1 Doors and frames shall be stacked in such a way as to prevent failing and damage. Do not stack higher than indicated on shipping container. Do not stack on top of other material.

.2 Protect face of first door by placing plywood or cardboard between supports and door. Cover top door and edges in a similar manner.

.3 Store doors in a dry, well ventilated area. Doors stored for an extensive period of time shall have top and bottom edges sealed.

.4 Lift doors on and off piles, never drag across each other to prevent surface damage and scratching. Do not stand doors on end for storage.

1.8 Warranty

1.8.1 In addition to the contractual warranty terms, the manufacturer shall provide a lifetime warranty for the door and frame against failure due to corrosion, and a 15-year warranty.

.1 The warranty shall cover: Defects in material and workmanship, delaminating, core expansion and warp

2 PRODUCTS

2.1 Design Criteria

2.1.1 Design exterior frame assembly to accommodate for expansion and contraction when subjected to minimum and maximum surface temperature of –35°C to 35°C.

.1 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

.2 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with NFPA 252 for ratings specified or indicated.

.3 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC S104 or NFPA 252 and listed by nationally recognized agency having factory inspection services.

2.1.2 Maximum U-value of exterior door assemblies is to comply with the OBC supplementary standard SB-10.

2.2 Materials

2.2.1 Only steel doors and frames and product manufactured by CSDMA members are eligible for use on this project.

2.2.2 Sheet steel for:

.1 Exterior doors: commercial grade steel to ASTM A568, Class 1, hot-dip galvanized and coating designation ZF75 (A25) to ASTM A653/A653M. Minimum base steel thickness shall be as per Table 1 / CSDFMA.

.2 Exterior Frames: commercial grade steel to ASTM A568M, Class 1, hot dip galvanized to ASTM A653/A653M Z275 G-90.

2.2.3 Door Faces Sheet Metal:

.1 For exterior doors 1.519 mm (16 Gauge) base thickness.

2.2.4 Reinforcement channel: to CAN/CSA G40.21, Type 44W, coating designation to ASTM A653/A653M, ZF75.

2.2.5 Composites: balance of core materials used in conjunction with lead: in accordance with manufacturers' proprietary design.

2.3 Door Core Materials

2.3.1 Stiffened: face sheets welded, uninsulated and insulated core.

.1 Polyurethane: to CAN/ULC S704 rigid, modified poly/isocyanurate, closed cell board. Density 32 kg/m³.

2.3.2 Temperature Rise Rated (TRR): core composition to limit temperature rise on unexposed side of door to 250°C at 30 to 60 minutes. Core to be tested as part of a complete door assembly, in accordance with CAN/ULC S105 or NFPA 252, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized agency having factory inspection service.

2.3.3 Thermal insulation material must not require being labelled as poisonous, corrosive, flammable or explosive under the Consumer Chemical and Container Regulations of the Hazardous Products Act.

2.4 Adhesives

2.4.1 Select adhesives that are accompanied by:

.1 detailed instructions for proper application, so as to minimize health concerns and maximize performance; and

.2 information describing proper disposal methods for containers.

2.4.2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

2.4.3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.5 Primers

2.5.1 For touch-up prime rust inhibiting primer to MPI #18.

.1 Maximum VOC limit 50 g/L to GC-03.

2.6 Paint

2.6.1 Steel doors and frames shall be field painted in accordance with Section 09900 – Painting Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes.

2.7 Accessories

2.7.1 Door silencers: single stud rubber/neoprene type.

2.7.2 Frame Thermal Breaks: rigid polyvinyl chloride extrusion conforming to ASTM D4726.

2.7.3 Door Caps:

.1 Interior Doors top and bottom caps: Rigid polyvinyl chloride extrusion conforming to ASTM D4726

.2 Exterior doors top and bottom caps: steel cap.

2.7.4 Specialty trims: "J" shaped electrogalvanized steel trims, to cover cut ends of concrete blocks where new doors cut into existing walls. Trims shall be custom shaped and sized to suit door and wall conditions.

2.7.5 Metallic paste filler: to manufacturer's standard.

2.7.6 Floor Anchors, Channel Spreaders and Wall Anchors: Minimum I.6 mm (16 Gauge) base thickness steel.

2.7.7 Guard Boxes: Minimum 0.8 mm (21 Gauge) base thickness steel.

2.7.8 Corrugated Steel Frame Tee Anchors: Thickness and design approved by ULC.

2.7.9 Door bottom seal: to Section 08710 - Door Hardware.

2.7.10 Sealant: to Section 07900 – Joint Sealers.

2.8 Frames Fabrication General

2.8.1 Fabricate frames in accordance with CSDMA specifications.

2.8.2 Fabricate frames to profiles and maximum face sizes as indicated.

2.8.3 Exterior frames: 1.6 mm (16 Gauge) thermally broken type construction.

2.8.4 Blank, reinforce, drill and tap frames for mortised, templated hardware using templates provided by finish hardware supplier. Reinforce frames from surface mounted hardware.

2.8.5 Prepare frame for door silencers, three (3) for single door, two (2) at head for double door.

2.8.6 Manufacturer's nameplates on frames and screens are not permitted.

2.8.7 Conceal fastenings, except where exposed fastenings are indicated.

2.8.8 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

2.8.9 Insulate exterior frame components with polyurethane insulation.

2.8.10 Prepare frames for electrical devices, including operators and security devices.

2.8.11 Reinforce head of frames wider than 1200 mm.

2.9 Frame Anchorage

2.9.1 Provide appropriate anchorage to floor and wall construction.

2.9.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

2.9.3 Provide 1.5 mm angle clips, with two holes for floor anchorage welded to frame.

2.9.4 Provide two (2) anchors for rebate opening heights up to 1520 mm and one (1) additional anchor for each additional 760 mm of height or fraction thereof.

2.9.5 Provide three (3) jamb anchors per jamb for frames in masonry up to 2286 mm high and one (1) additional for each 600 mm over 2886 mm high for doors up to 900 mm wide.

2.9.6 Provide five (5) jamb anchors per jamb for frames in masonry up to 2286 mm high and one (1) additional for each 400 mm over 2286 mm for doors over 900 mm wide, unless noted otherwise.

2.9.7 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.9.8 Provide frames with manufacturer's proprietary anchorage system suitable to secure frame rigidly to wall assembly. Secure frames set into previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device.

2.10 Frames: Welded Type

2.10.1 Welded in accordance with CSA W59.

2.10.2 Accurately mitre or mechanically join frame product and secure weld on inside of profile.

2.10.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

2.10.4 Grind welded joints and corners to a flat plane; fill with metallic paste; and sand to uniform smooth finish.

2.10.5 Securely attach floor anchors to inside of each jamb profile.

2.10.6 Weld in two (2) temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10.7 Securely attach lead to inside of frame profile from return to jamb soffit, inclusive on door side of frame only.

2.11 Door Fabrication General

2.11.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

2.11.2 Exterior doors: hollow steel construction.

2.11.3 Fabricate doors with longitudinal edges welded.

.1 Seams: grind welded joints to a flat plane; fill with metallic paste filler; and sand to a uniform smooth finish.

2.11.4 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.

2.11.5 Factory prepare holes 12.7 mm diameter and larger, except mounting and through-bolt holes, on site, at time of hardware installation.

2.11.6 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

2.11.7 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

2.11.8 Manufacturer's nameplates on doors are not permitted.

2.12 Hollow Steel Construction

2.12.1 Form each sheet for exterior doors from 1.6 mm sheet steel.

2.12.2 Form each face sheet for interior doors from 1.6 mm steel.

2.12.3 Reinforce doors with vertical stiffeners, securely welded to each face sheet at 150 mm on centre maximum.

2.12.4 Hardware Reinforcing: 1.6 mm minimum.

2.12.5 Floor anchors: 1.6 mm minimum.

2.12.6 Channel spreaders: 1.2 mm minimum.

2.12.7 Guard boxes: 0.9 mm minimum.

2.12.8 Hinge reinforcing: 5.2 mm minimum.

2.12.9 Glass moulding: 0.9 mm minimum.

2.12.10 Jamb anchors: 1.6 mm minimum.

2.12.11 Top, bottom, door and channel: 1.2 mm minimum.

2.12.12 Frame members: 1.6 mm minimum.

2.12.13 Fill voids between stiffeners of exterior doors with fibreglass core.

2.13 Thermally Broken Doors and Frames

2.13.1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.

2.13.2 Thermal break: rigid polyvinylchloride extrusions conforming to ASTM D4726.

2.13.3 Fabricate thermally broken frames, separating exterior parts from interior parts, with continuous interlocking thermal break.

2.13.4 Apply insulation.

2.14 Acceptable products:

.1 D Series, manufactured by S.W. Fleming

.2 LS Series, manufactured by Daybar.

.3 TRR doors, manufactured by Metal Door Ltd.

3 EXECUTION

3.1 Manufacturer's Instructions

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Examination

3.2.1 All doors and frames shall be verified to comply with approved production drawings and meet the requirements for type, size, location and swing.

3.2.2 Notify the Engineer immediately of conditions that may adversely affect door installation. Correct conditions prior to installation

3.3 Installation General

3.3.1 Install doors and frames to CSDMA Installation Guide.

3.4 Frame Installation

3.4.1 Isolate from each other dissimilar metals and metal from concrete or masonry to prevent electrolysis.

3.4.2 Set frames plumb, square, level and at correct elevation.

3.4.3 Secure anchorages and connections to adjacent construction.

3.4.4 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

3.4.5 Make allowances for deflection of structures to ensure structural loads are not transmitted to frames.

3.4.6 Apply sealant to perimeter of frames between frame and adjacent material in accordance with section 7900.

3.4.7 Maintain continuity of air barrier and vapour retarder.

3.4.8 Install trims to cover cut concrete block ends in walls where new doors installed in existing block walls. Do not impede installation of finish floor and base to make good materials to match typical existing condition.

3.5 Door Installation

3.5.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08710 - Door Hardware.

3.5.2 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association

3.5.3 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:

.1 Hinge side: 1.0 mm.

.2 Latch side and head: 1.5 mm.

.3 Finished floor, top of thresholds: 13 mm.

3.5.4 Adjust operable parts for correct function.

3.5.5 Install louvres.

3.6 Finish Repairs

3.6.1 Touch-up with primer finishes damaged during installation.

3.6.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.7 Cleaning

3.7.1 Progress Cleaning: Perform cleanup as work progresses in accordance with Section 01740 Cleaning.

.1 Leave work area clean at end of each day.

3.7.2 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment in accordance with Section 01740 – Cleaning.

3.7.3 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

3.7.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 This section describes the materials and procedures for FRP Frame Products installed by trades in relation to building veneers and all openings through walls that will facilitate a door assembly.

1.2 Scope of Work

1.2.1 Work supplied under this section includes FRP Frame Products including frames, transom frames, side light and window assemblies, fire labelled and non-labelled, accessories as indicated on drawings and door schedule.

1.2.2 FRP doors, swing type, flush, glazed or louvered, fire labelled, with or without temperature rise ratings and rated louvers, and non-labelled as indicated on drawings and door schedule

1.3 Related Specifications Sections

1.3.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 07840 Fire Stopping.

.2 Section 07900 Joint Sealants

.3 Section 08710 Door Hardware

.4 Section 08800 Fire Rated and Safety Glass

.5 Division 9 Finishes

1.4 Code and Regulatory Requirements

1.4.1 All products shall conform to the following standards and regulations:

.1 American Society of Testing and Materials (ASTM):

.1 ASTM C665-12 – Standard Specification for Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

.2 ASTM D638-14 - Standard Test Method for Tensile Properties of Plastics

.3 ASTM D695-10 - Standard Test Method for Compressive Properties of Rigid Plastics

.4 ASTM D696-08e1 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer

.5 ASTM D790-10 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

.6 ASTME E84-15b – Standard Test Method for Surface Burning Characteristics of Building Materials

.2 Canadian Standards Association (CSA):

.1 CAN/CSA A440.4-07 (R2012) – Window, Door and Skylight Installation

.3 National Fire Protection Association (NFPA):

.1 NFPA 80-2007 - Fire Doors and Other Opening Protectives

.2 NFPA (Fire)-252 - Fire Tests of Door Assemblies, 2012 Edition

.4 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC S104-10 – Fire Tests of Door Assemblies

.2 CAN/ULC S105-09 – Standard Specification for Fire Door Frames Meeting Performance Required by CAN/ULC S104.

.3 CAN/ULC 702-09 –Mineral Fibre Thermal Insulation for Buildings

1.4.2 ANSI Door and Frame Preparations for Hardware

1.4.3 DHI Recommended Locations for Builders Hardware

1.5 Quality Assurance

1.5.1 Fire rated doors and frames, glazing stops, and fire door hardware shall bear ULC labels. Refer to architectural drawings for locations of fire rated assemblies. All FRP work in fire separations and fire walls shall be in accordance with NFPA 80 – latest edition of Standard for Fire Doors and Windows and CAN/ULC S104. See schedule for doors requiring a temperature rise limit.

1.5.2 Defective materials or quality of work whenever found at any time prior to final acceptance of the work, shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight and error. Remove and replace defective materials, and the work of other trades affected by this replacement, at no additional cost.

1.6 Submittals

1.6.1 General: Complete submittals in accordance with Specification Section 01330.

1.6.2 Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods.

1.6.3 Samples: Submit in accordance with Section 01330 – Submittal Procedures.

1.6.4 Shop Drawings: Submit in accordance with Section 01330 – Submittal Procedures.

.1 Details of each opening, showing elevations, glazing, louvered, frame profiles and identifying location of different finishes, if any.

.2 Indicate each type of door and frame, material, steel core thickness, mortises, reinforcements, stops, location of anchors, location of exposed fasteners, arrangement of hardware and fire rating.

.3 Include schedule identifying each unit with door marks and numbers relating to numbering on drawings and door schedule.

1.6.5 Colour: To be selected by the Consultantfrom provided manufacturer's samples of standard colours.

1.6.6 Warranty: Submit manufacturer's standard warranty.

1.7 Delivery Storage and Handling

1.7.1 Shipping and Delivery

.1 Doors and frames shall be shipped pre-hung in containers such as to prevent damage to finish.

.2 Doors and frames shall be delivered by common carrier with shipping containers intact and door manufacturer's name clearly identifiable. Manufacturers must be notified if shipping containers arrive damaged. Acceptance of damaged shipment may void warranty.

.3 Containers shall be labelled clearly identifying opening door mark.

.4 Co-ordinate delivery schedule of materials with the suppliers.

1.7.2 Handling and Storage

.1 Doors and frames shall be stacked in such a way as to prevent failing and damage. Do not stack higher than indicated on shipping container. Do not stack on top of other material.

.2 Protect face of first door by placing plywood or cardboard between supports and door. Cover top door and edges in a similar manner.

.3 Store doors in a dry, well ventilated area. Doors stored for an extensive period of time shall have top and bottom edges sealed.

.4 Lift doors on and off piles, never drag across each other to prevent surface damage and scratching. Do not stand doors on end for storage

1.8 Warranty

1.8.1 In addition to the contractual warranty terms, the manufacturer shall provide a lifetime warranty for the door and frame against failure due to corrosion, and a 15-year warranty.

.1 The warranty shall cover: Defects in material or workmanship, delaminating, core expansion and warp

2 PRODUCTS

2.1 Design Criteria

2.1.1 Design exterior frame assembly to accommodate for expansion and contraction when subjected to minimum and maximum surface temperature of –35°C to 35°C.

.1 FRP fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC S104 NFPA 252 for ratings specified or indicated.

.2 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC S104 or NFPA 252 and listed by nationally recognized agency having factory inspection services.

2.1.2 Maximum U-value of exterior door assemblies is to comply with the OBC supplementary standard SB-10.

2.1.3	Tensile Strength	55,000 psi	ASTM D638
2.1.4	Compressive Strength	50,000 psi	ASTM D695
2.1.5	Flexural Strength	50,000 psi	ASTM D790
2.1.6	Modulus of Elasticity	3.5 x 10 (6)	ASTM D790
2.1.7	Coefficient of Thermal Expansion	5.5 x 10 (-5)	ASTM D696

2.1.8 Surface Burning Characteristics, Class 1 Flame Spread = 25

2.1.9 Thermal Conductivity 0.1 – 0.24 btu-ft/hr-ft(2)-F

2.2 Approved Manufacturers

2.2.1 Universal Pultrusions, LLC, P.O. Box 1289, 100 Tillco Drive, Marhsall, AR., 72650. Contact Number: 870-448-4406. Website www.unipulllc.com.

2.2.2 Substitutions: Reference Section 01200 – Alternatives.

2.3 Materials

2.3.1 Fire Rated Door assemblies and fire rated glazing stops, material and construction approved by ULC

2.4 Doors and Frames

2.4.1 Requirements for all doors and frames.

.1 General: All door and frame sections shall be chemically welded at the factory.

.2 Reinforcing: FRP chemically welded at factory. All structural members shall utilize a chemically resistant UV stabilized resin system.

.3 Hardware Preparation: In accordance with DHI A115 Series, or as indicated on drawings. All door stiles shall have integral FRP reinforcement, chemically welded in place, and shall not contain corrosive material embedded as reinforcing for hinge locations. Doors and frames shall be factory drilled and mortised for all hardware indicated on drawings. Hardware provided by others. See Specification Section 08710 – Door Hardware.

.4 Finish: Factory finish with manufacturer's standard colour.

2.5 Doors

2.5.1 Exterior and interior (rated).

.1 Fabricate fire rated doors and frames in accordance with details, approved shop drawings and ULC requirements.

.2 General: Panels shall be manufactured of fibreglass reinforced plastic (FRP). Use polymers tailored to the specific (corrosive) environment and have a reinforced content of 65 percent by weight.

.3 Door Thickness: 45 mm (1¾ inches) of flush construction. Door shall be FRP, pultruded as a one piece monolithic panel, with integral stiles.

.4 Profile: Square. Panel shall fit flush with frame on all sides.

.5 Texture: Smooth

.6 Panel Thickness: 3 mm (1/8 inch) thick solid FRP faces free of seams and cracks. Stile edges shall be 14 mm (9/16 inch) thick solid FRP.

.7 Insulation Factor: R-9 total

.8 Top Rail: Pultruded tube profile designed to fit flush inside the door and be chemically welded with a two part adhesive.

.9 Bottom Rail: Pultruded inverted "U" channel profile designed to fit inside the door allowing for field trimming if needed. Pultruded tube profile to fit flush with bottom of door.

2.5.2 Core

.1 Material: High density, closed cell, Poly-isocyanurate sheets.

.2 Thickness: 38 mm.

.3 Compressive Strength: 16 psi minimum

2.6 Frames

2.6.1 Exterior and interior (rated).

.1 Fabricate fire rated doors and frames in accordance with details, approved shop drawings and ULC requirements.

.2 Material: 6 mm thick solid pultruded FRP profiles having no corrosive components or reinforcement.

.3 Width: 50 mm faces.

.4 Depth: 146 mm standard.

.5 Style: One piece chemically welded at factory.

.6 Door Stop: 13 mm x 59 mm.

.7 Corner Construction: Mitered with 102 x 102 x 10 mm pultruded FRP angle reinforcement with interlocking “L” shaped pultruded FRP brackets.

.8 Reinforcing: 8 mm pultruded FRP chemically welded at all hinge, strike and closer locations.

.9 Anchors: Furnished with six total wall anchors, type as specified on drawings.

.10 Fasteners: Type 316 CRSS (18-8 series corrosion resistant stainless steel).

.11 Blank, reinforce, drill and tap frames for mortised, templated hardware and electronic hardware using templates provided by finish hardware supplier. Reinforce frames from surface mounted hardware.

.12 Protect mortised cut-outs with FRP guard boxes.

.13 Prepare frame for door silencers, three (3) for single door, two (2) at head for double door.

.14 Manufacturer’s nameplates on frames and screens are not permitted.

.15 Conceal fastenings, except where exposed fastenings are indicated.

.16 Provide factory-applied touch-up primer at areas where coating has been removed during fabrication.

.17 Reinforce head of frames wider than 1200 mm.

2.7 Frame Anchorage

2.7.1 Provide appropriate anchorage to floor and wall construction.

2.7.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

2.7.3 Provide 1.5 mm angle clips, with two holes for floor anchorage welded to frame.

2.7.4 Provide two (2) anchors for rebate opening heights up to 1520 mm and one (1) additional anchor for each additional 760 mm of height or fraction thereof.

2.7.5 Provide three (3) jamb anchors per jamb for frames in masonry up to 2286 mm high and one (1) additional for each 600 mm over 2886 mm high for doors up to 900 mm wide.

2.7.6 Provide five (5) jamb anchors per jamb for frames in masonry up to 2286 mm high and one (1) additional for each 400 mm over 2286 mm for doors over 900 mm wide, unless noted otherwise.

2.7.7 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.7.8 Provide frames with manufacturer's proprietary anchorage system suitable to secure frame rigidly to wall assembly. Secure frames set into previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device.

2.8 Adhesives

2.8.1 Select adhesives that are accompanied by:

.1 detailed instructions for proper application, so as to minimize health concerns and maximize performance; and

.2 information describing proper disposal methods for containers.

2.9 Finishes

2.9.1 Doors and frames shall be supplied with grey primer coated with manufacturer’s standard colours. Colour to be determined as indicated by Engineer.

.1 Finish: Two-part aliphatic polyurethane, low VOC, industrial coating.

.2 Thickness: 5 mils.

.3 Sheen: Gloss.

.4 Impact Resistance: 140 in-lbs.

.5 Electrical Resistant: less than 10 megohms.

2.10 Accessories

2.10.1 Door silencers: single stud rubber/neoprene type.

2.10.2 Specialty trims: "J" shaped electrogalvanized steel trims, to cover cut ends of concrete blocks where new doors cut into existing walls. Trims shall be custom shaped and sized to suit door and wall conditions.

2.10.3 Fire labels: FRP chemically welded.

2.10.4 Floor Anchors, Channel Spreaders and Wall Anchors: Minimum 1.6 mm base thickness steel.

2.10.5 Guard Boxes: Minimum 0.8 mm base thickness steel.

2.10.6 Corrugated Steel Frame Tee Anchors: Thickness and design approved by ULC.

2.10.7 Door bottom seal: to Section 08710 - Door Hardware.

2.10.8 Sealant: to Section 07900 – Joint Sealers.

2.10.9 Glazing: to Section 08800 – Fire-Rated Wire and Safety Glass

2.10.10 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fasteners to frame sections with counter-sunk oval head sheet metal screws.

2.10.11 Make provisions for glazing as indicated and provide necessary glazing stops.

.1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersink stainless steel screws.

.2 Glazing Stops Fire Rated Doors and Frames: Commercial grade 16 Gauge sheet steel thickness and design approved by ULC.

3 EXECUTION

3.1 Manufacturer's Instructions

3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, datasheets and using non-corrosive materials. Installation shall be in strict accordance with local codes.

3.2 Examination

3.2.1 All doors and frames shall be verified to comply with approved production drawings and meet the requirements for type, size, location and swing.

3.3 Installation General

3.3.1 Install labelled FRP fire rated doors and frames to NFPA 80, except where specified otherwise.

3.4 Frame Installation

3.4.1 Install doors/frames plumb, level, square, true to line and without warp or rack. Anchor doors securely in place. Install doors to swing freely. After installation make final adjustments to hardware to allow for proper operation and latching.

3.4.2 Coordinate frame anchor placement with wall construction.

3.4.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

3.4.4 Make allowances for deflection of structures to ensure structural loads are not transmitted to frames.

3.4.5 Caulk perimeter of frames between frame and adjacent material.

3.4.6 Maintain continuity of air barrier and vapour retarder.

3.4.7 Install trims to cover cut concrete block ends in walls where new doors installed in existing block walls. Do not impede installation of finish floor and base to make good materials to match typical existing condition.

3.5 Door Installation

3.5.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08710 - Door Hardware. Install fire rated doors to NFPA-80, latest edition.

3.5.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:

.1 Hinge side: 1.0 mm.

.2 Latch side and head: 1.5 mm.

.3 Finished floor, top of thresholds: 13 mm.

3.5.3 Adjust operable parts for correct function.

3.5.4 Install louvres.

3.6 Finish Repairs

3.6.1 Touch-up with primer finishes damaged during installation.

3.6.2 Fill exposed frame anchors and surfaces with imperfections with frp filler and sand to a uniform smooth finish.

3.7 Glazing

3.7.1 Install glazing for doors and frames in accordance with Section 08800 – Fire-Rated Wire and Safety Glass.

3.8 Cleaning

3.8.1 Clean exposed surfaces of FRP doors and frames with a mild, non-abrasive cleaner and water.

3.8.2 Do not use harsh cleaning materials or methods that would damage finish.

3.8.3 Progress Cleaning: Perform cleanup as work progresses in accordance with Section 01740 Cleaning.

.1 Leave work area clean at end of each day.

3.8.4 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment in accordance with Section 01740 – Cleaning.

3.8.5 Waste Management:

.1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

.2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.1 Section Includes

1.1.1 Fire-rated glazing materials installed in fire-rated window, door, transom, sidelite and borrowed lite assemblies and safety glass.

1.2 Related Sections

1.2.1 Drawings, General and Supplementary Conditions of the Contract, Division 1 and the following Specification Sections, apply to this Section.

.1 Section 08200 – FRP Doors and Frames.

1.3 References

1.3.1 CAN/CGSB-12.11-M – Wired Safety Glass.

1.3.2 National Building Code.

1.3.3 UL9 – Standard for Fire Tests of Window Assemblies.

1.3.4 UL10B – Standard for Fire Tests of Door Assemblies.

1.3.5 UL10C – Standard for Positive Pressure Fire Tests of Door Assemblies.

1.4 Definitions

1.4.1 Fire-Rated Safety Glass

.1 Glass that has been placed in a specific fire-rated assembly and then tested as a barrier to smoke and flames for a specific time rating as well as meeting an impact rating per CPSC 16 CFR 1201.

1.5 System Description

1.5.1 Design Requirements

.1 Provide fire-rated glazing assemblies capable of withstanding smoke and flames for the time specified by code.

1.6 Submittals

1.6.1 Submit 100 x 200 mm samples of each type of fire glass indicated.

1.6.2 Submit manufacturer’s product data sheet and glazing instructions.

1.6.3 Glazing contractor shall verify that all code requirements necessary to satisfy the fire rating have been met. These include: fire glass application, framing, glazing system, stop height and fire glass area, width and height.

1.7 Quality Assurance

1.7.1 Comply with published recommendations of fire rated assembly manufacturers and organizations below, except where more stringent requirements are indicated herein. Refer to these publications for glazing terms not otherwise defined in this section or referenced standards.

.1 GANA Publications

.2 AAMA Publications

.3 NFPA Publications

1.7.2 Each lite of fire-rated glass shall bear a permanent, non-removable lable of UL or WHI certifying it for use in tested and rated fire protective assemblies.

1.7.3 Single-source fabrication responsibility.

.1 All glass fabricated for each type shall be processed and supplied by a single fabricator.

1.8 Delivery, Storage and Handling

1.8.1 Comply with manufacturer's instructions for receiving, handling, storing and protecting fire-rated glazing materials.

1.8.2 Delivery

.1 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

1.8.3 Storage and Protection

.1 Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.8.4 Exercise exceptional care to prevent edge damage to glass.

1.9 Project/Site Conditions

1.9.1 Environmental Requirements

.1 Installation of fire glass products at ambient air temperature below 4.4^0C is prohibited.

1.9.2 Field Measurements

.1 When construction schedule permits, verify field measurements with drawing dimensions prior to fabrication of fire glass products.

2 PRODUCTS

2.1 Manufacturers

2.1.1 Manufacturer is used in this section to refer to a firm that produces primary fire glass or fabricated fire glass as defined in the referenced standards.

.1 Oldcastle Glass

.2 CGI International Ltd.

.3 Pilkington

2.2 Materials

2.2.1 Monolithic Fire-Rated Glass (GL1)

.1 Application: As indicated on drawings.

.2 Nominal Thickness: 6mm or as required by manufacturer to meet performance and fire rating.

.3 Framing: FRP

.4 Glazing System: As required to maintain fire rating of tested assembly.

.5 Stop Height: As required to maintain fire rating of tested assembly.

.6 Fire Rating: As indicated on drawings, to match tested assembly performance (90 minutes, or as scheduled).

2.2.2 Canadian Requirements

.1 Fire-rated glazing shall comply with CAN/ULC-S104 and CAN/ULC-S106, and be listed with an accredited testing/certification agency (e.g., Intertek, UL).

.2 Acceptable products include clear fire-rated ceramic glazing or multi-laminate intumescent glazing systems. Wired glass shall not be used.

2.2.3 Glazing Compound

.1 Glazing Tape: As required to maintain fire rating of tested assembly.

.2 Setting Blocks: As required to maintain fire rating of tested assembly.

2.2.4 Fabrication

.1 Fabricate fire-rated glazing in sizes required to glaze openings indicated for project, with edge and face clearances, edge and surface conditions, and bite complying with tested assembly and manufacturer’s installation instructions.

3 EXECUTION

3.1 Examination

3.1.1 Site Verification and Conditions

.1 Verify that site conditions are acceptable for installation of the glass.

.2 Verify openings for glazing are correctly sized and within tolerance.

.3 Verify that the minimum required face and edge clearances are being followed.

.4 Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.2 Preparation

3.2.1 Protection

.1 Handle and store product according to manufacturer's recommendations.

3.2.2 Surface Preparation

.1 Clean and prepare glazing channels and other framing members to receive glass.

.2 Remove coatings and other harmful materials that will prevent glass and glazing installation required to comply with performance criteria specified.

3.3 Installation

3.3.1 Install products using the recommendations of manufacturers of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in the "GANA Glazing Manual".

3.3.2 Install glass in prepared glazing channels and other framing members.

3.3.3 Install setting blocks in rabbets as recommended by referenced glazing standards in GANA Glazing Manual.

3.3.4 Provide bite on glass, minimum edge and face clearances and glazing material tolerances recommended by GANA Glazing Manual.

3.3.5 Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.

3.3.6 Distribute the weight of the glass along the edge rather than at the corner.

3.3.7 Comply with manufacturer's and referenced industry recommendations on expansion joints and anchors, accommodating thermal movement, glass openings, use of setting blocks, edge, face and bite clearances, use of glass spacers, edge blocks and installation of weep systems.

3.3.8 Protect glass from edge damage during handling and installation.

3.3.9 Prevent glass from contact with contaminating substances that result from construction operations, such as weld spatter, fireproofing or plaster.

3.3.10 Remove and replace glass that is broken, chipped, cracked or damaged in any way.

3.3.11 Install vision panels in doors and sidelites in accordance with NFPA 80.

3.3.12 Install so that appropriate logos and markings remain permanently visible.

3.4 Cleaning

3.4.1 Clean excess sealant or compound from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.

3.4.2 Glass to be cleaned according to:

.1 GANA Glass Informational Bulletin GANA 01-0300 – Proper Procedures for Cleaning Architectural Glass Products.

3.4.3 Do not use scrapers or other metal tools to clean glass.

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 To establish the technical, functional, jurisdictional, or regulatory and quality requirements for the implementation of door hardware installed by trades including work in relation to doors and frames. These technical specifications define the supply and installation of the door hardware and identify approved manufacturers and models.

.1 Supply of finish hardware for all pedestrian doors, complete with all fixing and anchoring devices.

.2 Supply templates and information necessary for installation of hardware.

1.2 Scope of Work

1.2.1 Supply all labour, material, equipment and supervision necessary to complete the installation of door hardware.

1.3 Related Work

1.3.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 05500 Metal Fabrications

.2 Section 07900 Joint Sealants

.3 Section 08110 Steel Doors and Frames

.4 Section 08200 FRP Doors and Frames

1.4 Code and Regulatory Requirements

1.4.1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturer's Association.

1.4.2 American National Standards Institute (ANSI):

.1 ANSI/BHMA A156.1-2013 - Bored and Pre-assembled Locks and Latches

.2 ANSI/BHMA A156.2-2011 - Bored and Pre-assembled Locks and Latches

.3 ANSI/BHMA A156.3-2014 - Exit Devices

.4 ANSI/BHMA A156.4-2013 - Door Controls (Closers)

.5 ANSI/BHMA A156.36-2010 – Auxiliary Locks

.6 ANSI/BHMA A156.6-2010 - Architectural Door Trim

.7 ANSI/BHMA A156.7-2014 - Template Hinge Dimensions

.8 ANSI/BHMA A156.8-2010 - Door Controls – Overhead Stops and Holders

.9 ANSI/BHMA A156.12-2013 - Interconnected Locks and Latches.

.10 ANSI/BHMA A156.13-2012 - Mortise Locks and Latches

.11 ANSI/BHMA A156.15-2011 - Closer/Holder Release Device

.12 ANSI/BHMA A156.16-2013 - Auxiliary Hardware

.13 ANSI/BHMA A156.18-2012 - Materials and Finishes

.14 ANSI/BHMA A156.19-2013 – Power Assist and Low Energy Power Operated Doors

.15 ANSI/BHMA A156.21-2014 - Thresholds.

.16 ANSI/BMHA A156.22-2012 - Door Gasketing and Edge Seal Systems.

1.4.3 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA)

.1 CSDFMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.4.4 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

1.5 Quality Assurance

1.5.1 In addition to the requirements of 01450 – Quality Control, the following measures are required:

.1 Regulatory Requirements:

.1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 Submittals

1.6.1 General:

.1 Complete submittals in accordance with Specification Section 01330

1.6.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish, limitations and order code.

1.6.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.

1.6.4 Hardware List:

.1 Submit contract hardware list.

.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

1.6.5 Test Reports:

.1 Certified test reports showing compliance with specified performance characteristics and physical properties.

1.6.6 Closeout Submittals:

.1 Submit in accordance with Section 01780 – Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

.3 Submit manufacturer’s installation instructions with operation manual.

1.6.7 Warranty:

.1 Submit manufacturer’s standard warranty.

1.7 Maintenance Materials

1.7.1 Extra Stock Materials:

.1 Supply maintenance materials in accordance with Section 01780 – Closeout Submittals.

.2 Tools:

.1 Supply 2 sets of wrenches for door closers, locksets and fire exit hardware.

1.8 Delivery and Storage

1.8.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.8.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.8.3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

1.8.4 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect door hardware from nicks, scratches, and blemishes.

.3 Protect prefinished surfaces with wrapping and strippable coating.

.4 Replace defective or damaged materials with new.

.5 Clearly label cartons and packages designating contents and locations for which each item is intended. Indicate on packing memos carton in which each item is packed

2 PRODUCTS

2.1 Approved Manufacturers

2.1.1 Allegion, 11819 N. Pennsylvania St., Carmel, Indiana, United States 46032, Phone: (317) 810-3700, URL: www.allegion.com.

2.1.2 ASSA ABLOY Entrance Systems, 4020B Sladeview Crescent. Unit 3&4, Toronto, Ontario, Canada, L5L 6B1, Phone: (905) 608-9242, email: service.ca.aaes@assaabloy.com, URL: http://www.sargentlock.com

2.1.3 Best, 6161 East 75th Street, Indianapolis, IN, USA 46250, Phone: (855) 365-2407, e-mail, URL: www.bestaccess.com.

2.1.4 Canaropa, 1866 Kipling Avenue, Rexdale, Ontario, Canada M9W 4J1, Phone: (416) 241-4445, e-mail: salestor@canaropa.com, URL www.canaropa.com.

2.1.5 Door Security Solutions of Canada, 160 Four Valley Drive, Vaughan, Ontario, Canada V4K 4T9, Phone: (866)-243-9816, URL: www.pemko.com

2.1.6 Gallery Specialty, 676 Petrolia Road, Toronto, Ontario, Canada M3J 2V2, Phone: (416) 667-9593, e-mail: info@galleryspecialty.com, URL: www.galleryspecialty.com.

2.1.7 Hager, P.O. Box 124, Kitchener, Ontario, Canada N2C 1K1, Phone: (314) 772-4400, URL: www.hagerco.com.

2.1.8 Horton Automatics of Ontario, 1150 Blai Road, Unit 1N, Burlington, Ontario, Canada L7M 3T4, Phone: (905) 331-7491, email: brian@hortonontario.com, URL: www.hortonontario.com

2.1.9 K.N. Crowder MFG Inc., 1220 Burloak Drive, Burlington, Ontario, Canada L7L 6B3, Phone: (905) 315-9788, e-mail: paiken@dmbsales.ca, URL: www.kncrowder.com.

2.1.10 McKinney Products Company, 225 Episcopal Road, Berlin, Connecticut, USA 06037, Phone: (800)-888-2772, email: ed.soloski@assaabloy.com, URL: http://www.mckinneyhinge.com/en/site/mckinney-hinge/

2.1.11 Sargent Manufacturing Company, 100 Sargent Drive, New Haven, Connecticut, United States 06536-0915, Phone: (800) 727-5477, e-mail: webmaster@sargentlock.com URL: www.sargentlock.com.

2.1.12 Standard Metal Hardware Mfg Ltd., 29 Rangemore Road, Toronto, Ontario, Canada M8Z 5H8, Phone: (416)-744-1510, URL: www.smhardware.com

2.1.13 Stanley Hardware, 711 Ontario St., Cobourg, Ontario, Canada K9A 4L3, Phone: (800)-667-7466, email: HDW-NAT-CustomerService-CBG@spectrumhhi.com, URL: http://ca.stanleyhardware.com/

2.2 Hardware Items

2.2.1 Only door locksets and latches listed on CGSB Qualified Products List are acceptable for use on this project.

2.2.2 Use one (1) manufacturer's products only for all similar items.

2.3 Door Hardware

2.3.1 Provide new materials in perfect condition, free from defects impairing durability or appearance. In every case hardware shall be of high quality design, and finish suitable for the purpose for which it is intended.

2.3.2 Locks and latches

.1 Bored and preassembled locks and latches: to ANSI/BHMA A156.2.

.2 Interconnected locks and latches: to ANSI/BHMA A156.12.

.3 Mortise locks and latches: to ANSI/BHMA A156.13.

.4 Normal strikes: box type, lip projection not beyond jamb.

.5 Cylinders: key into keying system as outlined in section 2.6 Keying.

2.3.3 Operators

.1 Exit devices: to ANSI/BHMA A156.3.

.2 Exterior Operators:

.1 Finish to 630 (US32D) Satin stainless steel

.2 Acceptable products:

.1 Exterior exit device with rim latch – (EO1)

.1 Sargent 8813 x ETJ 32D

.2 Von Duprin 98L x 996L-R/V 03 LEVER - 32D

.3 Precision 2108 x V4903C x 630

.2 Exterior fire rated exit device with rim latch – (EO2)

.1 Sargent 8813 x ETJ 32D

.2 Von Duprin 98L-F x 996L-R/V 03-32D

.3 Precision FL2108 x V4903C x 630

.3 Interior Operators:

.1 Finished to 626 (US26D) Satin Chromium plated.

.2 Acceptable product:

.1 Interior fire rated exit device with rim latch and lever trim (IO2)

.1 Sargent 80 Series 12-8815 x ETJ

.2 Von Duprin 98-L-BE-03-F

.3 Precision FL2114 x 4900C x 626

2.3.4 Butts and Hinges:

.1 As listed in drawing Door Schedule.

.1 Butts and hinges: to ANSI/BHMA A156.1.

.2 Exterior doors to be with non-removable pins.

.3 Provide one (1) hinge for every 760 mm of door height and one (1) extra hinge for doors over 900 mm wide to 1200 mm width.

.4 Acceptable product:

.1 Hinges on locked doors: (H1)

.1 Hager BB1191 X 114 X 101 X NRP X 630

.2 Stanley FBB191 X 114 X 101 NRP X 32D

.3 McKinney TA2314 X 114 X 101 NRP X 32D

.2 Standard Hinges: (H2)

.1 Hager BB1279 X 114 X 101 X 626

.2 Stanley FBB179 X 114 X 101 X 26D

.3 McKinney TA2714 X 114 X 101 X 26D

2.3.5 Door Closers and Accessories:

.1 As listed in drawing door schedule,

.2 Door closers: to ANSI/BHMA A156.4.

.3 Door co-ordinator: surface for pairs of doors with overlapping astragal.

.4 Finished to 628.

.5 Acceptable products:

.1 Exterior Closers - (CL1)

.1 LCN #4041 Series

.2 Stanley D-4551

.3 Sargent 351 Series

.2 Interior Closers - (CL2)

.1 LCN #1461 Series

.2 Stanley D-3551

.3 Sargent 351 Series

2.3.6 Concealed vertical rod by same manufacturer as exit device.

2.3.7 2.3.6 Door Coordinators

.1 Required on all exterior double doors listed in door schedule: (DC1)

.1 Acceptable products:

.1 Dorma SR 390

.2 Ives COR9G

.2 Acceptable products for smoke and fire rated doors: (DC2)

.1 Dorma SR 392

2.3.8 Architectural Door Trim:

.1 As listed in door Schedule.

.2 Finished to 630 (US32D) Satin stainless steel.

.3 Length of Kick plate:

.1 25mm, less than door width on double doors.

.2 40mm, less than door width on single doors

.4 Door protection plates (Stainless steel_0.05” gauge):

.1 Kickplates (DT1)

.1 Hager #190S X 203 X LENGTH

.2 Standard Metal K10A 200 X LENGTH.

.3 IVES 8400 S 200 X B4E

.2 Mop plate - (DT2)

.1 Hager #224S X 100 X LENGTH

.2 Standard Metal K30

.3 IVES 8400 S 100 X B4E

.3 Push plates - (DT4)

.1 Hager A30S X 152 X 406.

.2 Standard Metal K11A 152 X 406.

.3 IVES SC8200 152 X 406

.4 Pull units - (DT5)

.1 Hager 34G X 152 X 406.

.2 Standard Metal 9009 No. 2.

2.3.9 Auxiliary Hardware: to ANSI/BHMA A156.16

.1 As listed in Hardware Requirements Schedule.

.2 Finished to 630 (US32D) Satin stainless steel.

.1 Door Stop

.1 Floor Stops - (DS1)

.1 Hager #259F & 259H.

.2 Standard Metal S108 & S107

.3 IVES FS17

.2 Wall Stop - (DS2)

.1 Hager #234W

.2 Standard Metals S121

.3 IVES WS404CVX

.2 Flush bolts:

.1 Internally mounted – (FB2)

.1 Standard Metal F65UL

2.3.10 Thresholds - (TH1)

.1 101 mm wide x full width of door opening, extruded aluminum.

.2 Finished to 628 (US28) Satin aluminum, clear anodized

.3 Acceptable material:

.1 Crowder #CT-64.

.2 Pemko 270A.

2.3.11 Weatherstripping:

.1 Fire Rated Door head and jamb seal - (WS1F)

.1 Extruded aluminum frame and closed cell neoprene insert.

.2 Acceptable material:

.1 Crowder #W13.

.2 Pemko 319CR.

.2 Fire Rated Door bottom seal - (WS2F)

.1 Extruded aluminum frame and closed cell neoprene insert.

.2 Acceptable material:

.1 Crowder #W14.

.2 Pemko 315CN

2.3.12 Astragal:

.1 Astragal - (AS1)

.2 Adjustable compensating, overlapping, extruded aluminum frame with vinyl pile insert, finished to match doors.

.1 Acceptable material:

.1 Crowder W-8P

.2 Pemko 355CP

.3 Fire Rated Astragal - (AS2)

.4 Extruded aluminum frame with nylon insert, finished to match doors

.1 Acceptable material:

.1 Crowder: W-25

2.4 Fastenings

2.4.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

2.4.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

2.4.3 Exposed fastening devices to match finish of hardware.

2.4.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices and install so pull can be secured through door from reserve side. Install push plate to cover fasteners.

2.4.5 Use fasteners compatible with material through which they pass.

2.5 Keying

2.5.1 Lay out the keying system for the building in consultation with the Engineer and Client. Keying shall match existing facility keying system.

2.5.2 Keying chart and related explanatory data shall be prepared and submitted to the Engineer for approval, and lock work shall not be commenced until written confirmation of keying arrangements is received from the Engineer.

2.5.3 Provide keys in duplicate for every lock in this contract.

2.5.4 Supply 3 master keys for each master key or grand master key group.

2.5.5 Stamp keying code numbers on keys and cylinders.

2.5.6 Supply construction cores.

2.5.7 Hand over permanent cores and keys to Client.

3 EXECUTION

3.1 Installation Instructions

3.1.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.1.2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

3.1.3 Supply manufacturer’s instructions for proper installation of each hardware component.

3.1.4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).

3.1.5 Where door stop contacts door pulls, mount stop to strike bottom of pull.

3.1.6 Install key control cabinet.

3.1.7 Use only manufacturer's supplied fasteners.

.1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

3.1.8 Remove construction cores when directed by the Engineer.

.1 Install permanent cores and ensure locks operate correctly.

3.2 Adjusting

3.2.1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.

3.2.2 Lubricate hardware, operating equipment and other moving parts.

3.2.3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 Cleaning

3.3.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.

.3 Remove protective material from hardware items where present.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01740 Cleaning.

.5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01740 Cleaning.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 Demonstration

3.4.1 Keying System Setup and Cabinet:

.1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.

.2 Place file keys and duplicate keys in key cabinet on their respective hooks.

.3 Lock key cabinet and turn over key to Engineer.

3.4.2 Maintenance Staff Briefing:

.1 Brief maintenance staff regarding:

.1 Proper care, cleaning, and general maintenance of projects complete hardware.

.2 Description, use, handling, and storage of keys.

.3 Use, application and storage of wrenches for door closers, locksets and fire exit hardware.

.2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.5 Protection

3.5.1 Protect installed products and components from damage during construction.

3.5.2 Repair damage to adjacent materials caused by door hardware installation.

END OF SECTION

DIVISION 9 – FINISHES

Section No.	Title
09255	PVC Wall and Ceiling Liner
09672	Epoxy Coating - Medium
09900	Paint

1 GENERAL

1.1 Intent

1.1.1 This section describes the supply and installation of rigid PVC interlocking wall and ceiling liner panels manufactured by continuous extrusion. Panels are 12 mm thick, available in standard widths of 410 mm (nominal), and produced in lengths as required. Standard colour is bright white, with uniform colour through the thickness and smooth surfaces on both exposed and back sides.

1.2 Related Specification Sections

1.2.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 06101 Rough Carpentry

.2 Section 06310 Prefabricated Wood Roof Trusses

.3 Section 07270 Self-Adhered Air Vapour Barrier Membrane

1.3 Code and Regulatory Requirements

1.3.1 All products shall conform to the following standards and regulations:

.1 ASTM International Inc.

.1 ASTME 84–Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM D4226- Standard Test Method for Impact Resistance

.3 ASTM G21- Standard Test Method Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

.2 Canadian Food Inspection Agency (CFIA) Approval

1.4 Quality Assurance

1.4.1 In addition to the requirements of 01450 – Quality Control, the following measures are required:

.1 Panel shall be rigid PVC Compound, virgin and regrind. Window grade PVC with UV stabilizer.

.2 Panels will be smooth surface. Colour will be uniform throughout, as specified. Other colours can be manufactured. Backside will also be smooth. Fastening flange will have holes.

.3 Quality standards and tolerances for panel weight and thickness will be set forth according to MSW Canadian Plastics standards and dimensions which are available upon request.

.4 Dimensions shall be specified as per drawings if required, and are subject to reasonable tolerances.

.5 Panels shall be installed in accordance with manufacturer's guidelines as set forth in MSW Canadian Plastics "Installation Guide and Warranty".

1.4.2 Contractors Qualifications

.1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

.2 Meets requirements for Class A fire rating as per ASTM E84 – flame spread 25.

1.5 Submittals

1.5.1 Complete submittals in accordance with Specification Section 01330

1.5.2 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

1.5.3 Samples: For each finish product specified, two samples.

1.5.4 Shop Drawings: Submit plan, section and elevation drawings to depict the actual construction of each unit type specified, and to depict proper attachment and installation techniques. Coordinate locations with those indicated on the contract drawings.

1.5.5 Closeout Submittals: Provide maintenance data for cleaning and maintenance for incorporation into operations manual

1.5.6 Warranty: Submit unexecuted warranty for review

1.5.7 Alternatives

.1 Comparable Products from other manufacturer not listed herein will be accepted provided they meet equivalent performance of listed products and after full review by the Engineer.

1.6 Delivery Storage and Handling

1.6.1 Refer to Specification Section 01610

1.6.2 Protect materials from weather elements and extreme temperatures.

1.6.3 Store materials as packaged, flat and straight. Prevent packaging and product from deformation.

1.7 Environmental and Site Conditions

1.7.1 Refer to Specification Section 01610

1.7.2 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Panels should be installed at temperatures that are within 4°C degrees of operating temperature

1.7.3 Cold Temperatures –Do NOT install panels at temperature at or below 0°C degrees.

1.8 Warranty

1.8.1 At project closeout, provide to Owner or Owner's Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

.1 Term: Limited Lifetime.

2 PRODUCTS

2.1 General

2.2 Approved Manufacturers

.1 Parent Manufacturer: MSW Plastics, Inc. Located at: 140 Minto Road Palmerston, ON N0G2P0 Phone:(888)418-4679 Fax: (866) 457-9859

.2 Equivalent products may be submitted for Engineer’s approval providing the product submitted meets or exceeds the performance criteria of the products specified.

2.3 Materials

2.3.1 PVC PANELS (PVC1)

.1 Product: Trusscore™ PVC Interlocking Liner Panel

.1 Description: Tongue-and-groove, rib-reinforced wall panels with nailing fins.

.2 Material: PVC

.3 Outside Surface: Flat.

.4 Width:410mm

.5 Thickness: 12mm.

.6 Weight: 0.8 pounds per square foot

.7 Surface Burning Characteristics, ASTM E 84: Class A

.1 Flame Spread Index: 10.

.2 Smoke Developed Index: 400.

.8 Color: White

.9 Corrosion proof

.10 Waterproof, Nonporous

2.3.2 ACCESSORIES

.1 Product: Trusscore™ PVC Trim

.1 Description: J Trim, Outside Corner, Inside Cove, Base Trim, H Divider and F-Channel.

.2 Material:PVC, 100 percent virgin

.3 Color: White

2.4 Fabrication

2.4.1 Protect your eyes with goggles. Protect your ears with plugs or muffs.

2.4.2 Cutting: use a circular with a plywood blade or mitre saw with a 120-tooth blade.

2.4.3 Use flat or pan head screws, #10 or greater. Do not over tighten. See “Installation Guide and Warranty”.

2.4.4 Strap wall and ceiling with wood or steel strapping at a minimum of two foot on centre intervals.

3 EXECUTION

3.1 General

3.2 Examination

3.2.1 Examine product prior to installation and inform the supplier in writing if manufacturer defects are evident.

3.2.2 Do not begin installation until substrates have been properly prepared.

3.2.3 If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.2.4 Beginning of installation indicates acceptance of site conditions.

3.3 Installation

3.3.1 Preparation

.1 Check surfaces for straightness and install strapping where necessary. Make sure that all vapour barriers etc. are installed to code prior to PVC panel being installed.

.2 It is recommended that PVC panel panels run parallel to ceiling joists, roof trusses or wall studs. When additional strapping has to be installed a 1” x 4” or 2” x 4” should be the minimum that is installed. It is always good practice to check with local authorities before proceeding. Installing strapping perpendicular to the framing members every 24” is recommended. Load tables are available for larger spans.

.3 Install wood blocking around all openings to properly support trims.

.4 When planning to suspend lighting or other items, install adequate backing at each location as required.

3.3.2 BASIC INSTALLATION

.1 All panels should be allowed to slide free after nailing to allow for expansion and contraction. Always fasten in the center of the slots. Allow a minimum of 1/16” (about the thickness of a dime) between the back of the fastener head and the nailing flange. Leave a minimum of ¼” clearance at ends of all panels and trims to allow for expansion and contraction.

.2 Fasteners should penetrate a minimum of 1” into solid backing and be no more than 24” apart and at least 4” from the end of the panel. Before fastening, double-check to make certain that PVC panel is interlocked along its entire length. Keep the joints uniform to ensure that all joints remain parallel. Also make certain that PVC panel can slide freely, nail properly by starting at the center of the panel and working outwards.

.3 Use a one-part, neutral cure silicone sealant to seal all corners, to seal around all fixtures and to repair small holes. The sealant color should be off-white to match the liner panel.

3.3.3 CEILING INSTALLATION

.1 Begin by installing the necessary trim on the perimeter of the ceiling. Fasten trim at 24” maximum to wood strips or the ceiling members along the perimeter of the ceiling area.

.2 Cut the width and length of the first panel for the first course. Install into the necessary trim at one corner of the ceiling. Be sure to leave room in the trim for 1/8” expansion at the side and for ¼”expansion at the end. Fasten every 24” maximum, positioning fasteners in the centre of the slots. Do not fasten tightly. Do not fasten within 4” of the end of the panels.

.3 Install an H-Trim on the end of the first course leaving room for expansion ¼”. Fasten the H-Trim on the other side to wood supports at 24” on center.

.4 As the installation proceeds install J-Trim around all openings. Cut the panels to suit the J-Trim. Be sure to leave room for expansion of the paneling and the J-Trim (As per Basic Installation 1.)

3.3.4 WALL INSTALLATION

.1 Install PVC panel on walls in a similar manner to the ceiling installation.

.2 When installing PVC panel Panels on walls and ceilings, install the wall panels first, before installing the Inside Cove Trim for the ceiling.

.3 Begin by installing the Base Trim along the bottom of the wall. If using a “J” Trim be sure to drill ¼” dia. drain holes in the bottom of the J-Trim at 16” on center for drainage.

.4 You have a few options when coming to an inside corner:

.1 At corners, install J-Trim vertically to finish the ends of the butt joints.

.2 Install the inside cove trim when the panel comes to the corner, then proceed with the rest of the wall installation starting at the inside cove moulding and work away from it.

.5 If the ceiling is not finished or an inside cove trim is not used install a “J” Trim to the top of the PVC panel Panel.

3.4 Cleaning

3.4.1 Clean in accordance with Section 01740- Cleaning.

3.4.2 To remove common dirt and grime and maintain your PVC panel panels beautiful appearance, wash using a long-handled sponge or soft bristle brush and a mild cleaning solution. If the dirt is hard to remove, wipe clean with a solution of:

.1 - 1/3 cup laundry detergent (e.g. Tide®)

.2 - 2/3 cup Tri-sodium phosphate (e.g. Soilax®)

.3 - 1 gallon of water

.4 Protect eyes and skin from direct contact with cleaning agents.

.5 Leave work area clean at end of each day.

3.4.3

1 GENERAL

1.1 Intent

1.1.1 The Contractor shall supply labour, materials and equipment for the complete installation of epoxy flooring on all interior concrete floors as listed on the drawings. General floor coating shall form a covered 150 mm curb along all walls and cover all maintenance pads in all rooms. Protective coating in the chemical containment areas shall be finished from finished floor to top of all containment walls and curbs height as shown on drawings.

1.2 Related Specification Sections

1.2.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

.1 Section 03300 Cast-in-Place Concrete.

1.3 Code and Regulatory Requirements

1.3.1 All products shall conform to the following standards and regulations:

.1 American Society for Testing and Materials (ASTM):

.1 ASTM D16-14-09- Standard Terminology Relating to Paint, Related Coatings, Materials and Applications

.2 ASTM D4259-88 (2012) - Standard Practice for Abrading Concrete

.3 ASTM D4263-83 (2012) - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

.4 ASTM F1869-16a - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

.2 International Concrete Repair Institute (ICRI)

.1 Guideline No. 310.R-2013: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

.3 Society for Protective Coatings (SSPC)

.1 SSPC-TR 5/ICRI Technical Guideline 03741/NACE 02203 - Design, Installation, and Maintenance of Protective Polymer Flooring Systems for Concrete

.2 SSPC-Guide 20 - Procedures for Applying Thick Film Coatings and Surfacings Over Concrete Floors

.3 SSPC-TU 2/NACE 6G197 - Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment

.4 SSPC SP13/NACE No. 6 - Surface Preparation of Concrete

.5 References herein are as detailed in Systems and Specifications SSPC Painting

.6 Manual, Volume 2, published by the Society for Protective Coatings (formerly the Steel Structures Painting Council), 40 24th Street 6th Floor, Pittsburgh, PA, 15222-4656 (www.sspc.org).

.4 NACE International (NACE)

.1 NACE SP0892-2007 - Coatings and Linings over Concrete for Chemical Immersion and Containment Service

.2 References herein are as published by NACE International (the National Association of Corrosion Engineers), Technical Practices Committee, 1440 South Creek Drive, Houston, Texas, 77084-4906 (www.nace.org).

1.4 Definitions and Abbreviations

1.4.1 Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000 inch)

1.5 Quality Assurance

1.5.1 In addition to the requirements of 01450 – Quality Control, the following measures are required:

.1 Perform work in accordance with the printed requirements of the resinous flooring manufacturer and this specification. Advise Engineer of any discrepancies prior to commencement of the work.

.2 Maintain one (1) copy of the specification and manufacturer's literature on site throughout the execution of the work.

.3 At the beginning of the work and, at all times during the execution of the work, allow access to the site by the resinous flooring manufacturer's representative.

1.5.2 Single Source Responsibility: Obtain primary protective resins including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than 10 years of successful experience in manufacturing the principle materials described in this section. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.

1.5.3 Manufacturer Qualifications:

.1 No request for substitution shall be considered that would change the generic type of system specified. Equivalent materials of other manufacturers may be substituted only on approval of the Engineer. Requests for substitution will be considered only if submitted 10 days prior to bid date. Requests shall include the respective manufacturer's technical literature for each product giving the name, generic type, descriptive information, recommended dry film thickness (DFT), Material Safety Data Sheet (MSDS), and certified test reports showing results to equal performance criteria of products specified herein.

1.5.4 Applicator Qualifications:

.1 Pre-Qualification: Each bidder for this project shall be pre-qualified and approved in writing by the material manufacturer.

.2 Applicators: Use experienced applicators having a record of successful in-service resinous flooring system applications similar in material and extent to those specified in this Section and as follows:

.1 Applicators must have completed flooring manufacturer's training program for Products specified.

.2 Applicators must be licensed, certified or approved in writing by the flooring manufacturer for the Products specified.

.3 Applicator Experience: Minimum 5 years' experience in the application of the type of system specified. Applicator shall submit a list of five (5) projects of similar size, scope and complexity.

1.5.5 Mock-Up:

.1 Construct one 10 sq.m. (100 sq.ft.) mock-up of each type and colour of resinous flooring in location acceptable to Consultant to demonstrate quality of finished system, complying with manufacturer's installation instructions and requirements of this Section in accordance with Section 01450 Quality Control.

.2 Arrange for Consultant's review and acceptance, obtain written acceptance before proceeding with Work.

.3 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the Work of this Section. Mock-up shall be left in place for the duration of the Work.

.4 During job mock-up and initial period of installation, manufacturer of coating system will provide a trained employee to insure proper use and installation of product. Periodic site visits will also be made during installation to verify continued proper installation.

1.5.6 Pre-installation meetings: comply with Section 01120 - Coordination and Sequence of Construction. Conduct pre-installation meeting two weeks prior to commencing work of this Section and on-site installations to:

.1 Notify attendees 3 weeks prior to meeting and ensure meeting attendees include as minimum:

.1 Owner;

.2 Engineer;

.3 Applicator

.4 All Affected Subcontractors;

.5 Manufacturer's Technical Representative.

.2 Coordinate with related specification listed in section 1.3 - Related Specification Sections

.3 Verify project requirements, including mock-up requirements.

.4 Verify substrate conditions, preparation and priming.

.5 Co-ordinate products, installation methods and techniques.

.6 Sequence work of related sections.

.7 Co-ordinate with other building sub-trades to ensure proper installation and site preparation.

.8 Review manufacturer's installation instructions, including application, curing and protection procedures.

.9 Review warranty requirements.

1.6 Submittals

1.6.1 Make Submittals in accordance with Section 01330 Submittals.

1.6.2 Production Data:

.1 Submit product data for each type of product specified including manufacturer's technical product data, installation instructions, colors available and recommendations for each type of resinous flooring product required for the following items;

.2 MSDS: Submit Manufacturer's Safety Data Sheet for each Product being used.

1.6.3 Product Samples:

.1 Upon Engineers request, submit manufacturer's colour charts showing the full range of colours available for each type of finish coat material indicated for Consultant's initial selection.

1.6.4 Applicator Certificate:

.1 Submit certificate issued to system applicator or written letter indicating applicator is recognized and approved to install specified system by coating material manufacturer.

1.6.5 Samples for Verification:

.1 Submit samples of each colour and material being applied, with texture to simulate actual conditions, on representative samples of the actual substrate and as follows for Consultant's verification:

.2 Use representative colours when preparing samples for review; resubmit until required sheen, colour, and texture are achieved.

.3 List of material and application for each coat of each sample; label each sample for location and application.

.4 Submit samples on the following substrates for Consultant's review of colour and texture:

.1 Hardboard: Provide 300 mm x 300 mm square samples for each colour and finish.

.5 Obtain written acceptance of Samples in writing from the Consultant before commencing Work of this Section. Accepted Samples shall be the final standard of acceptance of the finish.

1.6.6 Warranty:

.1 Submit an unexecuted, unsigned warranty for review, clearly stating that the traffic coating name, the terms of the specified warranty and duration, prior to any installation.

1.7 Closeout Submittals

1.7.1 Make Closeout Submittals in accordance with Section 01780 Closeout Submittals.

1.7.2 Operations and Maintenance Data: Submit manufacturer's printed maintenance instructions for repair, cleaning and maintenance procedures; include name of original installer and contact information.

1.8 Delivery, Storage and Handling

1.8.1 Refer to Specification Section 01610 - General Equip. Stipulations.

1.8.2 Delivery:

.1 Applicator will check material for completeness and shipping damage prior to job start.

.2 All materials must be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on-site mixing errors. No on-site weighing or volumetric measurements allowed.

.3 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number and date of manufacture.

1.8.3 Storage:

.1 Store materials in accordance with manufacturer’s written instructions.

.2 Keep containers sealed until ready for use. Material should be stored in a dry, enclosed, protected area from the elements.

.3 Do not subject material to excessive heat or freezing.

.4 Shelf life: Established based on manufacturer’s written recommendation for each material being used.

1.8.4 Handling:

.1 Protect materials during handling and application to prevent damage or contamination.

.2 Condition materials for use accordingly to manufacturer's written instructions prior to application.

.3 Record material lot numbers and quantities delivered to jobsite/storage.

1.9 Environmental and Site Conditions

1.9.1 Do not install the Work of this Section outside of the following environmental ranges without Manufacturers' written acceptance:

1.9.2 Supply temporary utilities, including power, water, temporary ventilation and lighting for use by applicator.

1.9.3 Maintain constant ambient room temperature for 48 hours before, during and after installation or until cured. Minimum temperature of 10°C (50°F) and maximum temperature of 30°C (85°F). Do not apply Product while ambient and substrate temperatures are rising.

1.9.4 Erect suitable barriers and post legible signs at points of entry to prevent traffic and trades from entering the work area during application and curing period of the floor.

1.9.5 Ensure adequate ventilation and air flow.

1.10 Warranty

1.10.1 Submit Warranty information in accordance with Section 01770 – Closeout Procedures.

1.10.2 Submit Applicator's written warranty, signed and issued in the name of Owner warranting the Work of this Section against defects in materials and workmanship for a period of one (1) year from the date of Substantial Performance of the Work.

1.10.3 Resinous flooring manufacturer must submit a written warranty, signed and issued in the name of the Owner, certifying resinous flooring will remain in place in accordance with General Condition article CG-12.3, except the warranty period shall be 20 years from the date of substantial completion. The warranty must remain a full warranty for the duration of the period specified. The scope of this warranty must not be limited by other system components manufactured or distributed by the resinous flooring manufacturer. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

1.10.4 Contractor must submit a written warranty, signed and issued in the name of the Owner, certifying resinous flooring will remain in place for a period of 20 years from the date of substantial completion. This warranty will cover the removal and replacement of defective resinous flooring products, including labour. The warranty must remain a full warranty for the duration of the period specified. The scope of this warranty must not be limited by other system components manufactured or distributed by the resinous flooring manufacturer. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

.1 Materials: 20 years.

.1 All resinous flooring system materials are to be supplied by the resinous flooring manufacturer.

2 PRODUCTS

2.1 Approved Manufacturers

2.1.1 Stonhard, Whitby, Local: 905-430-3333. Web Site www.stonhard.com

2.1.2 Tnemec Company, Missouri, Local: 905-339-8386. Web Site www.tnemec.com.

2.1.3 Sika Canada Inc. Mississauga, Local 905-795-3177. Web Site www.sika.ca

2.1.4 BASF Master Builders Solutions, Mississauga, Local: 647-385-5728, Web Site: www.master-builders-solutions.basf.us

2.2 Materials

2.2.1 Type 1 (EP1) - Floor coating in all rooms, unless otherwise specified, shall be 100 percent solids epoxy coating applied in two (2) coats of 4 to 6 mils DFT per coat, 8 to 12 mils total. The finish shall have a slip resistant finish with the addition of 50/60 mesh silica sand into the final coat with backrolling of the final coat.

.1 Stonhard Stonkote GS4

.2 Tnemec Series 237/281

.3 Sikafloor 261 System 1

.4 MasterTop GP 500

2.2.2 Type 2 (EP2) - Secondary Containment for all floors and walls in the containment structure protected with a 3 mm (125 mils) fiberglass reinforced lining system consisting of a resinous mortar base, reinforcement, and resin coating finish.

.1 Coating Systems for:

.1 Sodium Hypochlorite 12 percent,

.2 Hydrofluorosilicic Acid 25.7 percent

.3 Acceptable Products:

.1 Stonhard Stonchem 877

.2 Tnemec Series 239SC/120

.3 Sikafloor CRV 10

.4 MasterProtect 170CR

2.3 Colour

2.3.1 Epoxy floor coating, concrete curbs and pads shall be colour Stonhard GS4-6003 Silver Grey or Tnemec 31GR Silver Gray or Sika Agate Gray RAL 7038 or approved equal.

2.3.2 Lining system colour to be manufacturer's standard gray

3 EXECUTION

3.1 Examination

3.1.1 Examine surfaces to receive coating system. Submit Notice in Writing to Consultant, Contractor, and Owner if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected. Do not apply coating system to substrate treatments for moisture, repair, or levelling not of the same manufacturer.

3.1.2 Beginning of installation indicates acceptance of site conditions.

3.1.3 Inspect the work area for moisture control issues, thermal control issues, sharp fins, honeycomb, bug holes and cracks that need repair prior to coating application.

3.1.4 Concrete substrate must be properly cured for a minimum of 30 days. A calcium chloride test in accordance ASTM F1869 is required to determine acceptable moisture content of any horizontal concrete surfaces. All vertical concrete surfaces shall be tested in accordance with ASTM D4263.

3.1.5 Temperature: Utilities, including electric, water, heat (air temperature between 16º and 32ºC) and finished lightning to be supplied by General Contractor. Maintain ambient temperature of not less than 18ºC and a floor temperature of not less than 16ºC from seven (7) days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40 percent during same period.

3.1.6 Moisture: Ensure substrate is within moisture limits prescribed by the coating or lining manufacturer.

3.1.7 Safety: Comply with requirement of Workplace Hazardous Material Information Systems (WHMIS) regarding the use, handling, storage and disposal of hazardous materials.

3.1.8 Job area to be free of other trades during and, for a period of 24 hours, after coating and lining installation.

3.2 Preparation

3.2.1 Manufacturer's representative must be on the job site at start of installation and provide the Engineer with a written report verifying acceptable installation procedures are followed.

3.2.2 Substrate: Concrete surfaces shall be prepared by mechanical means such as a shot blast (blastrac) machine or sand blasting for removal of bond inhibiting materials such as curing components and laitance. Work to be completed in accordance with SSPC SP13/NACE No. 6 and ICRI Guideline 310.2R-201303732. In no case shall acid etching be utilized as the surface preparation method.

3.2.3 All coating surfaces shall be dried, brushed and vacuumed before primer is applied.

3.2.4 A manufacturer's representative shall visit the site, arranged by the Contractor, and review the substrate preparation before any product is applied. The representative shall confirm in writing that the area is suitably prepared. This written confirmation is required to be submitted to the engineer before product is applied.

3.3 Type 1: Floor Coating Application

3.3.1 Coating: Mix coating according to manufacturer's recommended procedures.

3.3.2 Joint Sealant: Install manufacturer's epoxy or urethane sealant compatible with floor finish.

3.3.3 Allow epoxy coating to cure at least the minimum required time as noted by the manufacturer to establish tack-free surface.

3.4 Type 2: Lining Application

3.4.1 Control Joint and Crack Treatment: All shrinkage cracks and control joints to be treated with a flexible reinforced system such as in accordance with SSPC TU 2/NACE 6G197 Technology Update Report Figure 7. Bidder shall estimate 10 percent of surface area for such treatment and provide a linear foot price for additions and deletions. Flexible reinforced systems:

.1 Stonhard Stonproof CT5

.2 Tnemec Series 206

.3 Sika Sikaflex 2C NS or SL

.4 BASF MasterSeal CR 190

3.4.2 Expansion Joints: All expansion joints, as indicated on the drawings, shall be treated with either the Horizontal Expansion Joint Detail or the Horizontal/Vertical Expansion Joint Detail as per drawings and Figure 1 of the SSPC TU2/NACE 6G197 Technology Update Report.

3.4.3 Key In: Create key in terminations at all lining terminations as shown in Figure 8 of the SSPC TU2/NACE 6G197 Technology Update Report.

3.4.4 Primer: Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates. Coordinate timing of primer application with application of troweled mortar to ensure optimum adhesion between resinous lining materials and substrate

3.4.5 Mortar: Mix mortar material according to manufacturer's recommended procedures. Uniformly spread mortar over substrate. Hand trowel apply mixed material over freshly primed substrate

3.4.6 Engineering Fabric: Embed fabric into mortar material with strict adherence to manufacturer's installation procedures

3.4.7 Saturant: Uniformly roll the saturant into the fiberglass fabric as recommended in manufacturer's application procedures

3.4.8 Topcoat: Remove any surface irregularities. Mix and apply resin finish topcoat with strict adherence to manufacturer's installation procedures.

3.5 Curing

3.5.1 Cure flooring and lining materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

3.6 Clean Up

3.6.1 Clean in accordance with Section 01740- Cleaning.

3.6.2 Disposal of this product, solution and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements.

3.6.3 Progress Cleaning: Perform cleanup as work progresses

.1 Leave work area clean at end of each day.

3.6.4 Final cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment

3.7 Protection

3.7.1 The General Contractor is responsible for protection, including all required repairs and restoration as a result of improperly protected product installation, and final cleaning of surface after final coats.

3.7.2 Protect freshly applied Products from dampness, condensation and water for at least seventy-two (72) hours.

3.7.3 Monitor air flow and changes in air flow. Protect against introduction of dust, debris, and particles, etc. that may result in surface imperfections and other defects.

3.7.4 Follow manufacturer's written recommendations with respect to cure, wait time and return to service.

END OF SECTION

1 GENERAL

1.1 Intent

1.1.1 This section describes the materials and procedures for painting and coatings.

1.2 Scope of Work

1.2.1 Work under this section includes providing paint or coatings but not limited to:

.1 Surface preparation of substrate

.2 Provision of materials, labour, and equipment required to complete painting or coatings works

.3 Waste management and disposal of materials

1.3 Related Sections

1.3.1 Section 04220 – Concrete Masonry Unit

1.3.2 Section 05500 – Metal Fabrications

1.3.3 Section 08110 – Steel Doors and Frames

1.3.4 Section 10200 – Louvres and Vents

1.3.5 DIVISION 11 – EQUIPMENT

1.3.6 DIVISION 15 – MECHANICAL

1.3.7 DIVISION 16 – ELECTRICAL

1.4 References

1.4.1 The Master Painters Institute (MPI):

.1 MPI Architectural Painting Specification Manual 2005

.2 MPI Approved Products List, 2012

1.4.2 American Society for Testing and Materials (ASTM):

.1 ASTM D3960-05 (2013) - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings

.2 ASTM D523-14 (2018) - Standard Test Method for Specular Gloss

1.4.3 Underwriters Laboratories of Canada (ULC):

.1 UL 2760 - Surface Coatings: Recycled Water-borne

.2 UL 2768 - Standard for Sustainability for Architectural Surface Coatings

1.4.4 Environmental Protection Agency (EPA):

.1 EPA SW-846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

1.4.5 Society of Protective Coatings

.1 SSPC-SP 1 - Solvent Cleaning

.2 SSPC-SP 2 - Hand Tool Cleaning

.3 SSPC-SP 3 - Power Tool Cleaning

.4 SSPC-SP 6/NACE No. 3 - Commercial Blast Cleaning

.5 SSPC-SP 7/NACE No. 4 - Brush-off Blast Cleaning

1.4.6 National Fire Code of Canada 2015

1.5 Submittals

1.5.1 Make submittals in accordance with Section 01330 – Submittal Procedures.

1.5.2 All paint systems to be submitted at same time for coordination and colour selection.

1.5.3 Provide on cover letter, listing all submitted products with MPI products numbers and categorized by MPI formula systems as outlined in this specification.

1.5.4 Submit full records of all products used. List each product in relation to finish formula and include the following:

.1 Finish formula designation

.2 Product type and use

.3 Manufacturer's product number

.4 Colour number

.5 Manufacturer's Material Safety Data Sheets (MSDS)

.6 Maximum VOC classification

.7 Eco-Logo certification.

.8 Submit manufacturer's application instructions for each product specified.

1.5.5 Product Data:

.1 Subcontractor to receive well written confirmation of specific surface preparation procedures and primers used for fabricated steel items from fabricator/supplier to

ensure appropriate and manufacturer compatible finish coat materials prior to commencement of painting.

.2 Subcontractor to receive written Product Data regarding chemical composition of coatings or treatments applied by others (pressure preservatives, admixtures and sealers, etc.) and their paintability.

.3 Submit Product Data for concrete and concrete block primers.

1.5.6 Samples: Submit physical samples of the standard colour range showing full range of available colours where colour availability is restricted.

.2 Submit samples 30 days before materials are required. Submit the following samples in sizes indicated:

.1 Three (3) copies of brushouts minimum 200mm x 250mm of each finish including colour, sheen and texture required 30 days prior to commencement of application. Identify each sample with job, finish, colour name, number, sheen and gloss values, substrate to be applied to, date and name of Subcontractor.

1.5.7 Surface Preparation

.1 Submit manufacturer's representative's written approval of surface preparation methods and any specific recommendations for alternative methods.

1.5.8 Scheduling

.1 Submit work schedule for various stages of painting to Engineer for approval. Submit schedule minimum of two (2) working days in advance of proposed operations.

.2 Obtain written authorization from Engineer for any changes in work schedule.

1.5.9 Progress Reports

.1 Arrange to have paint manufacturer's representative inspect work of this Section on a regular basis and prepare weekly reports. Submit a copy of the reports to the Engineer.

1.5.10 Closeout Submittals

.1 Submit three (3) copies of list of materials used, together with MSDS for each Product for incorporation into the Operations and Maintenance Manuals. Include maintenance information such as cleaning and full pigment information for future touch up.

1.5.11 Extra Materials

.1 Submit one (1) unopened four-litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish formula.Deliver to Engineer and store where directed.

1.6 Quality Assurance

1.6.1 Execute work of this Section by a firm which has adequate plant, equipment and skilled workers to perform work expeditiously and which is known to have been responsible, during immediate past 5 years, for installations similar to the scope of work contained herein. Ensure firm is fully conversant with applicable laws, bylaws, codes, fire, health and safety regulations and other regulations which govern.

1.6.2 Provide work of this Section executed by competent applicators with membership in good standing in OPCA and/or PDCA and have a minimum of 5 years experience in application of Products, systems, coatings and assemblies specified and with approval and training of Product manufacturers.

1.6.3 Retain purchase orders, invoices and other documents to prove that all materials utilized in this contract meet requirements of the specifications. Produce documents when requested by engineer.

1.6.4 Retain the bat or lot number for each product.

1.6.5 Pre-installation meetings: Prior to the commencement of painting operations meet at the Site with the material supplier's representative and with the Engineer to review this Section, the painting Work to be done and the following related items:

.1 Equipment use and servicing

.2 Material storage and application techniques

.1 Surface preparation and ambient temperature

.2 Inspection requirements

.3 Inspection reports

.4 Hold points or check points

.5 Safety requirements during application

.6 Mock ups or samples of coatings in highly corrosive environments

1.6.6 Standard of Acceptance:

.1 Walls: No defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.7 Delivery, Storage and Handling

1.7.1 Deliver and store materials in original containers, sealed, with labels intact.

1.7.2 Indicate on containers or wrappings:

.1 Manufacturer's name and address.

.2 Type of paint.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

1.7.3 Remove damaged, opened and rejected materials from site.

1.7.4 Provide and maintain dry, temperature controlled, secure storage. Store materials and supplies away from heat generating devices.

1.7.5 Store materials and equipment in a well-ventilated area with temperature range to meet the manufacturer's specifications.

1.7.6 Provide minimum one (1) 9 kg dry chemical fire extinguisher adjacent to storage area.

1.7.7 Remove only in quantities required for same day use.

1.7.8 Fire Safety Requirements:

.1 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use and dispose of flammable combustible materials in accordance with the National Fire Code of Canada.

1.8 Environmental Requirements

1.8.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials.

1.8.2 Ventilation:

.1 Contractor to provide continuous ventilation during and after application of paint. Run ventilation system 24 hours per day during installation and for seven (7) days after completion of application of paint.

1.8.3 Substrate and ambient temperature must be within limits prescribed by manufacturer to approval of Engineer.

1.8.4 Maintain minimum substrate and ambient air temperature of 10ºC. Maximum relative humidity 85 percent. Maintain supplemental heating until paint has cured sufficiently. Provide temporary heating where permanent facilities are not available to maintain minimum recommended temperatures.

1.8.5 Apply paint finish only in areas where dust is no longer being generated by related construction operations, such that airborne particles will not affect the quality of the finished surface.

1.8.6 Apply paint only when surface to be painted is dry, properly cured and adequately prepared.

1.9 Warranty

1.9.1 Warrant work of this Section for a period of 2 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which became apparent within warranty period, to satisfaction of the Engineer and at no expense to the Owner. Defects include but are not limited to material and workmanship defects such as:

.1 Improper cleaning and preparation of surfaces.

.2 Entrapped dust and dirt.

.3 Material shrinkage, cracking, splitting and defective workmanship.

2 PRODUCTS

2.1 Materials

2.1.1 Paint materials for each coating formula to be products of a single manufacturer.

2.1.2 Regulatory Requirements:

.1 Conform to latest edition of Industrial Health and Safety Regulations issued by applicable authorities having jurisdiction in regard to site safe.

.2 Comply with more stringent of applicable laws, bylaws, codes, fire regulations, health and safety regulations of authorities having jurisdiction or requirements. Ensure standards used for work of this Section are considered a minimum.

.3 Where required, ensure paints and coatings meet flame spread and smoke developed ratings designated by local code requirements and/or authorities having jurisdiction.

.4 Conform to requirements of local authorities having jurisdiction in regard to storage mixing application and disposal of paint and related waste materials.

2.1.3 Low odour products: whenever possible, select products exhibiting low odour characteristics. If two (2) products are otherwise equivalent, select the product with the lowest odour.

2.1.4 Water based paints and coatings must maintain a minimum surface and ambient air temperature of between 18°C and 32°C during application and drying of paint and maintain until building occupancy occurs.

2.1.5 Solvent based paints and contains must maintain a minimum interior surface and ambient air temperature of between 7°C and 35°C during application and drying of paint and maintain until building occupancy occurs.

2.1.6 Where required, use only materials having minimum MPI “Environmental Friendly” E3 rating based on VIC (10 CFR 59)

2.1.7 Where indoor air quality (odour) is an issue, use only MPI listed materials having a minimum E3 rating.

2.1.8 Water-borne surface coatings must:

.1 Meet or exceed all applicable governmental and/or industrial safety and performance standards.

.2 Manufactured and transported in such a manner that all steps of the process, including the disposal of waste products arising therefrom, will meet the requirements of all applicable governmental acts, bylaws and regulations including, for facilities located in Canada, the Fisheries Act and the Canadian Environmental Protection Act (CEPA).

2.1.9 Water-borne surface coatings must not be formulated or manufactured with: aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.

2.1.10 Water-borne surface coatings and recycled water-borne surface coatings must have a flash point of 61ºC or greater.

2.1.11 Water-borne surface coatings and recycled water-borne surface coatings must contain information describing proper disposal methods within their packaging.

2.1.12 Recycled water-borne surface coatings must not contain:

.1 Lead in excess of 600.0 ppm weight/weight total solids.

.2 Mercury in excess of 50.0 ppm weight/weight total product.

.3 Cadmium in excess of 1.0 ppm weight/weight total product.

.4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.

.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

2.1.13 Substitution Limitations:

.1 Comparable Products from other manufacturer not listed herein will be accepted provided they meet requirements of MPI Approved paints and this Specification after full review by the Engineer.

2.2 Colours

2.2.1 Contractor to provide available colour sample demonstrating full range from selected manufacturer after Contract award.

2.2.2 Engineer will provide colour schedule based upon the submitted colour sample.

2.2.3 Selection of colours will be from manufacturer’s full range of colours.

2.2.4 Where specific products are available in a restricted range of colours, selection will be based on the limited range.

2.2.5 Perform all colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials allowed only with Engineer's written permission.

2.2.6 Second coat in a three-coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 Interior Paint Finishes / Coatings

2.3.2 Concrete Masonry Units (CMU's):

.1 INT 4.2G (PT1) Epoxy tile-like finish (for wet environments) over epoxy block filler – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

2.3.3 Structural Steel and Metal Fabrications:

.1 INT 5.1D Alkyd dry fall finish over alkyd metal primer; by the following manufacturers:

.1 Benjamin Moore

.2 PPG Architectural

.3 Sherwin-Williams

2.4 Exterior Paint Finishes / Coatings

2.4.1 Structural Steel and Metal Fabrications:

.1 EXT 5.1F Epoxy finish over high build epoxy – premium grade; by the following manufacturers:

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

2.4.2 Galvanized Metals:

.1 EXT 5.3C: Epoxy finish – premium grade; by the following manufacturers:.

.1 Cloverdale Paint

.2 PPG Architectural

.3 Sherwin-Williams

3 EXECUTION

3.1 General

3.1.1 Perform all painting operations in accordance with MPI Architectural Painting Specification Manual, except where specified otherwise.

3.1.2 Apply all paint materials in accordance with paint manufacturer's written application instructions.

3.1.3 Commencement of work does not imply acceptance of surfaces except as qualified herein. Surfaces such as concrete, masonry, structural steel and miscellaneous metal, wood, gypsum board and plaster, is not responsibility of this Subcontractor. Commencement of work implies acceptance of previously completed work.

3.2 Preparation

3.2.1 Provide scaffolding, staging, platforms and ladders, as required for execution of work. Erect scaffolding to avoid interference with work of other trades. Comply with the Occupational Health and Safety Act.

3.2.2 Remove electrical cover plates, light fixtures, surface hardware on doors, door stops, bath accessories and all other surface mounted fittings and fastenings prior to undertaking any painting operations. Store for re-installation after painting is completed.

3.2.3 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

3.2.4 Prohibit traffic, where possible, from areas where painting is being carried out and until paint is cured.

3.2.5 As painting operations progress, place "WET PAINT" signs in occupied areas to approval of Engineer.

3.3 Protection

3.3.1 Protect existing building surfaces not to be painted from paint splatters, markings and other damage. If damaged, clean and restore such surfaces as directed by Engineer.

3.3.2 Cover or mask floors, windows and other ornamental hardware adjacent to areas being painted to prevent damage and to protect from paint drops and splatters. Use non-staining coverings.

3.3.3 Protect items that are permanently attached such as Fire Labels on doors and frames.

3.3.4 Protect factory-finished products and equipment.

3.4 Existing Conditions

3.4.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Engineer all damage, defects, unsatisfactory or unfavourable conditions before proceeding with work.

3.4.2 Investigate moisture content of surface to be painted, and report findings to Engineer. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.4.3 If substrate is steel, do not apply coatings over or when surface temperature is within 3°C of the dew point.

3.4.4 If the substrate is wood, do not stain or paint if moisture reading is higher than 15%. Inspect work to assure surfaces are smooth, free from machine marks and nail heads have been countersunk.

3.4.5 If substrate is new plaster or masonry, allow to cure for 30 to 90 days. Ensure moisture content is between 12% to 14% and test for alkalinity and neutralize (pH 6.5 – 7.5) before proceeding with priming.

3.4.6 If substrate is gypsum board, inspect to ensure joints are completely filled and sanded smooth. Inspect surfaces for “nail popping”, screw heads not recessed and taped, breaks in surface or other imperfections.

3.4.7 Where Room Finish Schedule indicates existing and/or new wall finishes to be painted, existing surfaces such as existing door and frames, mechanical supply and return air grilles (walls and ceilings), access doors and electrical panels which have been previously painted to be painted for a complete finish room. If Room Finish Schedule indicates “-“ it denotes entire room need not be painted, paint only patched areas.

3.5 Cleaning

3.5.1 Clean all surfaces to be painted as follows.

.1 Remove all dust, dirt and other surface debris by vacuuming and wiping with dry, clean cloths.

.2 Wash surfaces with solution of T.S.P. bleach and clean, warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.5 To prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.6 Use trigger-operated spray nozzles for water hoses.

.7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean-up water-based paints.

3.5.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint or pre-treatment as soon as possible after cleaning and before deterioration occurs.

3.5.3 Sand existing surfaces with intact, smooth, high gloss coatings to provide adequate adhesion for new finishes.

3.6 Surface Preparation

3.7 Prepare substrate in accordance with the MPI Architectural Painting Specification Manual

3.7.1 Remove doors before painting to paint bottom and top edges and re-hang once dry. Do not paint stainless steel or bronze door butts. Paint or finish top and bottom edges of doors. Touch-up or refinish tops and edges after fitting.

3.7.2 Fire Resistant Coatings:

.1 Coordinate with coating manufacturer for surface preparation requirements to ensure proper adhesion of finish.

3.8 Surface Preparation – Metal

3.8.1 Prepare aluminum and galvanized steel by acid etching using MPI Product #25. Rinse with clean water and thoroughly dry.

3.8.2 Clean new metal surfaces to be painted by: removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with the following, as described in each of the painting systems in the MPI Architectural Painting Specification Manual:

.1 Solvent cleaning: SSPC-SP-1.

.2 Hand tool cleaning: SSPC-SP-2.

.3 Power tool cleaning: SSPC-SP-3.

.4 Commercial blast cleaning: SSPC-SP-6.

.5 Brush-off blast cleaning: SSPC-SP-7.

3.8.3 Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes and vacuum cleaning.

3.8.4 Do not apply paint until prepared surfaces have been accepted by Engineer.

3.9 Mixing Paint

3.9.1 Unless otherwise specified herein or pre-approved, paint to be ready and factory tinted.

3.9.2 Mix ingredients in container before and during use and ensure breaking-up of lumps, complete dispersion of settled pigment and uniform composition.

3.9.3 Thin paint for spraying according to manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Engineer.

3.9.4 Do not use kerosene or any such organic solvents to thin water-based paints.

3.10 Application

3.10.1 Method of application to be as approved by Engineer. Apply paint by brush, roller, air sprayer or airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.

3.10.2 Safety Precautions:

.1 When handling solvent coating materials, wear approved vapour/particulate respirator as protection from vapours. Dust respirators do no provide protection from vapours.

3.10.3 Brush application:

.1 Work paint into cracks, crevices and corners. Paint surfaces not accessible to brushes by spray, daubers or sheepskins.

.2 Brush out runs and sags.

.3 Remove runs, sags and brush marks from finished work and repaint.

3.10.4 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied and equipped with suitable pressure regulators and gauges.

.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.

.4 Brush out immediately all runs and sags.

.5 Use brushes to work paint into cracks, crevices and places that are not adequately painted by spray.

3.10.5 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Engineer.

3.10.6 Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

3.10.7 Allow surfaces to dry and properly cure, after cleaning and between subsequent coats, for minimum time period, as recommended by manufacturer.

3.10.8 Sand and dust between each coat to remove visible defects.

3.10.9 Finish tops of cupboards, cabinets and projecting ledges, both above and below sight lines as specified for surrounding surfaces.

3.10.10 Finish inside of cupboards and cabinets as specified for outside surfaces.

3.10.11 Finish closets and alcoves as specified for adjoining rooms.

3.10.12 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.10.13 Finish behind wall-mounted items.

3.10.14 Finish listed surfaces indicated on the Room Finish Schedule and/or noted on Drawings and as specified. Refer to Room Finish Schedule for type, location and extent of finishes required and include touch-ups and field painting necessary to complete work shown, scheduled or specified.

3.10.15 Finishes and number of coats specified in Room Finish Schedule are intended as minimum requirements guide only. Refer to manufacturer's recommendations for exact instructions for thickness of coating to obtain optimal coverage and appearance.

3.10.16 Do not paint baked paint surface, chrome plated, stainless steel, aluminum or other surfaces finished with final finish in factory. Finish paint primed surfaces.

3.10.17 Apply additional paint coats, beyond number of coats specified for any surface, to completely cover and hide substrate and to produce a solid, uniform appearance.

3.10.18 Apply primer coat soon after surface preparation is completed to prevent contamination of substrate

3.10.19 Provide paint coating thicknesses indicated, measured as minimum DFT.

3.11 Mechanical Electrical Equipment

3.11.1 In finished areas paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment. Colour and texture to match adjacent surfaces, except as noted otherwise.

3.11.2 In boiler room, mechanical and electrical rooms paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

3.11.3 In other unfinished areas leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch-up scratches and marks.

3.11.4 Touch-up scratches and marks on factory-painted finishes and equipment with paint as supplied by manufacturer of equipment.

3.11.5 Do not paint over nameplates.

3.11.6 Keep sprinkler heads free of paint.

3.11.7 Paint disconnect switches for fire alarm system and exit light systems in Red enamel.

3.11.8 Paint all fire protection piping Red.

3.11.9 Paint all natural gas piping Yellow.

3.11.10 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish, except for touch-up, as required and paint conduits, mounting accessories and other unfinished items.

3.12 Field Quality Control

3.12.1 Field inspection of painting operations to be carried out by independent inspection firm as designated by Engineer.

3.12.2 As work progresses and upon completion of work, submit written reports and manufacturers' confirmation that materials and application methods conform to manufacturers' requirements.

3.12.3 Advise Engineer when each applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

3.12.4 Cooperate with inspection firm and provide access to all areas of the work.

3.12.5 Non-Conforming Work:

.1 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction to Consultant at no cost to the Owner. Touch-up small affected areas, repaint large affected areas or areas without sufficient DFT of paint. Remove runs, sags, of damaged paint by scraper or by sanding prior to application of paint.

.2 Lack of uniformity – the following are considered non-conforming qualities:

.1 Brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas and foreign materials in paint coatings.

.2 Evidence of poor coverage at rivet heads, plated edges, lap joints, crevices, pockets, corners and re-entrant angles.

.3 Damage due to touching before paint is sufficiently dry or any other contributory cause.

.4 Damage due to application on moist surfaces or caused by inadequate protection from weather.

.5 Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.)

3.13 Waste Management

3.13.1 Disposal of paint waste:

3.13.2 Be responsible for removal and disposal of material and waste generated.

3.13.3 Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.) are hazardous Products and are subject to regulations for disposal. Obtain information on these controls from applicable authorities having jurisdiction.

3.13.4 Separate and recycle waste materials. Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility. Treat materials that cannot be reused as hazardous waste and dispose of in an appropriate manner.

3.13.5 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

3.13.6 To reduce amount of contaminants entering waterways, sanitary/storm drain systems or into ground adhere to the following procedures:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out. In no case clean equipment using free draining water.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Dry empty paint cans prior to disposal or recycling (where available).

.6 Close and seal tightly partly used cans of materials including sealants and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

.7 Set aside and protect surplus and uncontaminated finish materials not required by Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

.8 Cleaning

.9 Clean all surfaces to be painted as follows.

.10 Remove all dust, dirt and other surface debris by vacuuming and wiping with dry, clean cloths.

.11 Wash surfaces with solution of T.S.P. bleach and clean, warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.12 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.13 Allow surfaces to drain completely and allow to dry thoroughly.

.14 To prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.

.15 Use trigger-operated spray nozzles for water hoses.

.16 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean-up water based paints.

.17 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint or pre-treatment as soon as possible after cleaning and before deterioration occurs.

.18 Sand existing surfaces with intact, smooth, high gloss coatings to provide adequate adhesion for new finishes.

END OF SECTION

DIVISION 11 – EQUIPMENT

Section No.	Title
11000	Equipment General Requirements
11090	Identification and Labelling
11100	Misc Piping and Accessories Installation
11101	Piping Valves and Fittings
11101-S1	Valve Schedule
11170	Pipeline Pressure and Leakage Testing
11190	Pipe and Valve Supports
11210	Vertical Turbine Pumps
11210-S1	Vertical Turbine Pumps – Technical Data Sheet
11280	Fabricated SS Sluice Gate
11290	Valve and Gate Actuators
11340	Intake Screen and Air Backwash System
11350	Stationary Screens
11422	Sample Pump
11422-S1	Sample Pump – Technical Data Sheet
11530	Chemical Metering System and Storage
11540	Chemical Pipes, Valves and Fittings
11540-S1	Chemical Valve Schedule

1 GENERAL

1.1 Description

1.1.1 The work of this Section covers the general clauses for the supply and installation of all process equipment and other works as specified herein and/or indicated on the Contract Drawings.

1.1.2 Provide all labour and materials, obtain all necessary permits and pay all fees as may be required.

1.2 Coordination

1.2.1 Fully coordinate the work of all related Specification Sections. Use equipment specifications together with all site work, concrete, building, electrical and control Specifications as necessary in order to produce a fully coordinated product meeting all necessary specifications.

1.3 Shop Drawings

1.3.1 Refer to Section 01330 for the general requirements for shop drawings.

1.3.2 In addition to the requirements of Section 01330, submit the following specific information with shop drawings for each item of equipment specified in Division 11.

.1 Assembly drawings showing details of connections and terminations of equipment for connection by others.

.2 List of materials of construction, detailing the component parts and reference specifications (ASTM, CSA, ANSI, etc.).

.3 Motor operating data, including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, and description of construction, complete with illustrative drawings.

.4 Gearbox and drive data, including AGMA/ABFMA ratings for components, materials of construction, tolerances, and description of construction.

.5 Control schematics, text, and wiring diagrams as required to describe control operations.

.6 Required ancillary services including, but not limited to electrical, non-potable water and drains.

.7 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and point of connection for ancillary services.

.8 Start-up instructions including lubricant requirements, electrical requirements, etc.

.9 Details of coating systems to be applied.

.10 Details of insulation provided to prevent galvanic corrosion between mating surfaces constructed of dissimilar metals.

.11 A copy of the Contract Document mechanical layout drawings, control diagrams, and process and instrumentation diagrams, with addenda updates, that apply to the equipment marked to indicate special changes necessary for the supplied equipment. If no changes are required, mark the drawing(s) “no changes required”.

.12 A copy of the related specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check-marked to show specification compliance or marked to show deviations.

1.4 Handling and Storage

1.4.1 Provide all necessary equipment, materials and labour to off-load equipment at the Site. The methods employed for off- loading and handling must be to the satisfaction of the Consultant.

1.4.2 Before taking delivery of equipment, examine the equipment for any damage. Rectify damage to the equipment to the satisfaction of the Consultant or remove damaged material from the Site.

1.4.3 If not required for immediate use, adequately store and protect all equipment against weather damage and theft. Store mechanical and electrical equipment as recommended by the manufacturer and to the satisfaction of the Consultant.

1.5 Standards

1.5.1 The materials and workmanship employed in the manufacture of all equipment shall conform to the applicable standards established by the ASTM, AWWA, ANSI, CEC, COSB and CSA. Canadian Standards shall take precedence over American Standards in the case of duplication or conflicting requirements.

1.5.2 All electrical motors and equipment shall be built to EEMAC (Electrical and Electronic Manufacturers’ Association of Canada) standards with Canadian threads and bearings throughout and all motorized and electrical equipment shall be CSA approved or supplied in accordance with the rules and regulations of the local inspection authority and subject to its approval.

1.6 Factory Testing

1.6.1 Where witnessed factory testing is specified, provide 10 working days notice of the date when equipment will be ready for testing. Confirmation of the test date and time is to be provided three working days in advance of the tests. Equipment is not to be delivered to the Site until factory testing has been satisfactorily completed.

1.6.2 When certified factory testing of the equipment or any component is specified, provide the Consultant with two copies of required certified test reports showing that the equipment complies with the Specification, before the equipment is delivered to the Site. Additional copies are required for the Maintenance Data Manuals.

2 PRODUCTS

2.1 Flanges and Pipe Threads

2.1.1 Provide flanges on cast iron equipment and appurtenances that conform in dimension and drilling to ANSI B16.1, Class 125 and flanges on steel equipment and appurtenances that conform in dimension and drilling to ANSI B16.5, Class 150 unless otherwise specified.

2.1.2 Provide pipe threads that conform in dimension and limits of size to ANSI B1.1, coarse threaded series, Class 2 fit.

2.1.3 Provide flange assembly bolts that are heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Provide threads that conform to Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1. Where indicated, provide grade 304 stainless steel bolts of same specifications.

2.2 Bearings

2.2.1 Unless otherwise specified, provide oil or grease lubricated, ball or roller type equipment bearings, designed to withstand the stresses of the service specified. Rate each bearing in accordance with ABFMA Methods of Evaluating Load Ratings of Ball and Roller Bearings.

2.2.2 Provide equipment bearings that have a minimum B-10 rating life of 100,000 hours, as determined using the maximum equipment operating speed, unless otherwise specified.

2.2.3 Fit grease lubricated bearings, except those provided factory-sealed and lubricated, with easily accessible grease supply, flush, drain, and relief fittings. Use extension tubes where necessary. Provide standard hydraulic alemite type grease supply fittings.

2.2.4 Ensure that all grease fittings on the project are the same size, North American standard and compatible with the Region's standards.

2.2.5 Extend grease fittings to an accessible location.

2.2.6 Equip oil lubricated bearings with either a pressure lubricating system, or a separate oil reservoir type system. Provide each oil lubrication system to be of sufficient size to absorb the head energy generated in the bearing under a maximum ambient temperature of 40°C.

2.2.7 For pressure lubricating systems or oil reservoirs, provide a filler pipe and an external level indicator gauge. Provide a cap, complete with retention chain, for the oil inlet.

2.3 Critical Speed

2.3.1 For rotating equipment, ensure that operating speed is no more than 80 percent of the first critical speed unless otherwise specified.

2.4 V-Belt Assemblies

2.4.1 Select belt for not less than 150 percent of rated driver power. Where two sheave sizes are specified, ensure belt sizing is appropriate for both sets.

2.4.2 For explosion-proof equipment, use anti-static type belts.

2.4.3 Statically balance sheaves and bushings. Where sheaves and bushings are to operate at peripheral speeds greater than 1650 m/min., dynamically balance the assembly.

2.4.4 Separately mount sheaves on their bushings by means of three pull-up grub or cap tightening devices. Key seat bushings to the drive shaft.

2.5 Couplings

2.5.1 For equipment with drives over 0.375 kW and less than 120 kW, and where the driver is directly connected to the driven unit, provide a flexible coupling. Couplings shall accommodate angular misalignment, parallel misalignment, and end float and shall cushion shock loads and dampen torsional vibrations.

2.5.2 The flexible member of flexible couplings shall consist of a tire, with synthetic tension members bonded together in rubber. Attach the flexible member to flanges by means of clamping rings and cap screws, and attach the flanges to the stub shaft by means of taperlock bushings. Provide the equivalent of a shrunk-on fit. There will be no metal-to-metal contact.

2.5.3 For larger couplings, provide continuous sleeve flexible gear type, forged steel couplings.

2.5.4 Size each coupling as recommended by the coupling manufacturer for the specific application, considering applied power, speed of rotation, type of service, and other pertinent details.

2.6 Guards

2.6.1 On moving parts, provide sheet steel guards in accordance with workplace safety regulations. Fabricate of galvanized 14 gauge steel.

2.6.2 Paint guards after fabrication to the same standard as the attached equipment.

2.6.3 Guards shall be removable to facilitate maintenance of moving parts.

2.6.4 Make provision for extension of lubrication fittings through the guards.

2.7 Equipment Installation

2.7.1 Provide nameplate for all equipment in accordance with Section 11005.

2.7.2 Provide nameplates for all electrical and control panels supplied with equipment, in accordance with Section 11005 and Division 16 requirements.

2.8 Caution Signs

2.8.1 For caution signs, use vinyl stick-on type decals placed onto clean, smooth surface of equipment to be posted.

2.8.2 Where sufficient space exists, use decal applied to galvanized mild steel, fibreglass, or plastic sheet fastened to equipment.

2.8.3 Provide signs that read “CAUTION – AUTOMATIC EQUIPMENT MAY START AT ANY TIME”.

2.8.4 Make letters 25 mm in height, red, on a yellow background.

2.8.5 Provide mounting posts and hardware and mount close to guarded moving parts.

2.9 Gauge Taps and Test Plugs

2.9.1 Provide gauge taps on the suction and discharge side of pumps.

2.9.2 Install gauges at each location indicated.

2.9.3 Tap and install plugs at locations indicated in the drawings and as required to practically complete testing of piping and equipment.

2.10 Concrete Pads

2.10.1 Coordinate location of concrete pads for equipment.

2.10.2 Ensure that, unless otherwise shown, concrete pads are a minimum of 150 mm above finished floor elevation and extend a minimum of 100 mm outside of the equipment base.

2.10.3 Ensure that pads drain away from base.

2.10.4 Ensure that conduit, drains, piping, etc. required for the equipment, rise through the pad.

2.11 Equipment Bases

2.11.1 Refer to Division 3 and Division 5.

2.12 Anchor Bolts

2.12.1 For all permanently or intermittently submerged services and for all exterior mounting locations, provide stainless steel anchor bolts conforming to ASTM A320.

2.12.2 For all other anchor bolts, provide cadmium plated or galvanized steel anchor bolts conforming to ASTM A307, unless noted otherwise.

2.12.3 For rotating equipment over 35 kW, provide anchor bolts with sleeves and washers to permit adjustment during installation of the equipment.

2.12.4 Do not use drilled expansion or adhesive anchors for anchor bolts unless submitted and reviewed by the Consultant.

2.12.5 Design anchor bolts for lateral forces for both pullout and shear in accordance with the requirements of Division 5.

2.13 Equipment Base Templates

2.13.1 For rotating equipment where shown in the drawings, or specifically called for in the specifications for that equipment, provide an equipment base template for location of equipment anchor bolts to be embedded in concrete.

2.13.2 Manufacture the equipment base template of structural steel with stops or holes placed for the anchor bolts.

2.13.3 Provide access holes for the placement of grout or concrete, as applicable.

2.14 Jacking Screws

2.14.1 On all base mounted rotating equipment larger that 7.5 kW, provide jacking screws for the driver and the driven end to facilitate alignment.

2.14.2 Provide jacking screws consisting of a 12 mm nut welded to the frame of the equipment with the hole in a horizontal plane.

2.14.3 Provide a 12 mm bolt that fits through the nut and extends to the mounting feet.

2.14.4 Two jacking screws are required at each end of the equipment, one parallel to the axis of the equipment and one perpendicular.

3 EXECUTION

3.1 Delivery, Receiving and Storage Equipment

3.1.1 Arrange for delivery of all items of equipment to the Site of the work as required to meet the schedule.

3.1.2 Arrange for delivery of all anchor bolts, templates, embedded metals, and other materials required during the concreting placement and assembly of equipment.

3.1.3 Receive equipment at the Site, unload and examine it upon arrival for damage or defects and be responsible for its safekeeping, storage and installation. Immediately notify the Consultant and the supplier of any damages or defects in the equipment delivered.

3.1.4 Special measures shall be taken to ensure that electrical motors do not suffer from moisture, dust, dirt or mechanical damage if stored or installed and inactive.

3.1.5 Equipment storage, safekeeping and relocation of equipment from one area of the Site to another, for whatever reason, shall be the sole responsibility of the Contractor from the time of initial off-loading at the Site until the date of completion and acceptance by the Region.

3.1.6 Installation of Equipment:

.1 Furnish any appurtenant fittings and materials, not herein or elsewhere specifically mentioned or included, but necessary for the installation and operation of the equipment without additional payment.

.2 Provide all materials, labour and equipment to install complete and in full operation all the equipment specified herein.

.3 Install the equipment in strict accordance with the manufacturer’s instructions and to the satisfaction of the Consultant.

.4 Install all instruments with an in-line isolating valve and a tee and valve on their sample line to allow easy isolation from the process for maintenance and to allow air or moisture removal.

.5 Be fully acquainted with all Work involved in the complete installation of all equipment. Misunderstandings in regard to the nature or amount of Work to be done will not constitute grounds for extra payment.

.6 Ensure that no unnecessary strain is introduced into equipment due to connections with piping or other appurtenances.

3.2 Time of Completion

3.2.1 Delay in delivery of equipment or installation materials does not relieve the Contractor of the responsibility to complete the Contract within the agreed date for contract completion.

3.3 Manufacturers Services and Certification of Installation

3.3.1 Provide for all necessary services and expenses of trained personnel representing the manufacturers of various pieces of specified equipment, to ensure correctness of installation and include any start-up costs required by suppliers necessary to ensure satisfactory installation, testing and commissioning of the equipment.

3.3.2 Provide all materials, labour and equipment necessary to make any adjustments to the installation as required by the manufacturer or the Consultant until the equipment is fully tested and commissioned.

3.3.3 On completion of the installation and testing, obtain from the suppliers or the manufacturers concerned, certification that the equipment is installed correctly, is in full operational condition, and is operating in accordance with its design rating. Submit the original certificate to the Consultant and all copies necessary to comply with other submitted requirements. Certificates are to include a statement to the effect that any adjoining pipe is properly and independently supported and does not cause undue stress that would be detrimental to the equipment performance.

3.3.4 Co-ordinate the work of all equipment suppliers, fully commission all equipment and provide representatives from various manufacturers during plant testing and commissioning as required by the Consultant.

3.4 Acquaintance with Work

3.4.1 The Contractor shall be fully acquainted with all work involved in the complete installation of all equipment. At no time shall the Contractor make any claim that any misunderstanding existed in regard to the nature or amount of work to be done in relation to the installation, testing and commissioning of all specified equipment.

3.4.2 The Contractor shall obtain all necessary details from Equipment suppliers including dimensions and other information pertinent to the Work of this Contract.

3.5 Material and Workmanship

3.5.1 Material and equipment is to conform to the latest edition of applicable standards in force at the time of tendering. In the case of any conflict between the Specifications with any standards, the more stringent of the two applies.

3.5.2 Provide materials and equipment in conformance with the following:

.1 First class in every respect.

.2 Constructed and finished in a workmanlike manner.

.3 Fully suitable for the service intended.

.4 Selected and fabricated to best engineering practice.

3.5.3 Furnish safety devices, including shear pins, flexible coupling guards, belt guards and other pertinent items with the equipment.

3.5.4 Design machinery such that working parts are readily accessible for inspection and repair, and each part is suitable for the service required.

3.5.5 Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment. Specially pack electrical equipment to prevent damage by moisture. Cover equipment having exposed bearings and glands to exclude foreign matter.

3.5.6 Design equipment to have adequate strength, power and capacity for both continuous and intermittent service and have motors and other parts capable of starting and operating under any conditions or loading likely to occur under normal plant operating conditions.

3.5.7 Design the general mechanical and electrical equipment and particularly gearings, contacts and other wearing parts to satisfy the need for long periods of operation without frequent maintenance or attention.

3.5.8 Provide adequate and, as far as practicable, authentic means of lubrication for working parts. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for routine greasing.

3.5.9 Indicate on the Shop Drawings submitted, the type of lubricants to be used (readily available in Canada). Use grease nipples of a consistent type (Alemite button head type or equivalent).

3.5.10 Make lubrication points readily accessible using grease nipples and Type 316 stainless steel or copper tubing extensions where required. Secure the nipples and tubing to the equipment at appropriate locations.

3.5.11 Design equipment installed outdoors for service under climatic conditions typical for the area. Give particular attention to winter operating conditions.

3.6 Special Tools and Accessories

3.6.1 Furnish a set of any special tools, wrenches and accessories required for removing worn parts, for carrying out maintenance and for making adjustments. Special tools are those tools which, because of their limited use or purpose-made design, are not normally readily available, but which are necessary for maintaining the equipment.

3.7 Temporary Supports

3.7.1 Provide all necessary temporary supports and bracing to prevent the overloading of all floors and walls, while equipment is being installed. Ascertain the weights of all pieces of equipment from the manufacturer, and move equipment into position in a manner and at a time agreed upon by the Consultant and the Owner.

3.7.2 Provide eye bolts or hooks for the safe handling of the equipment during installation. Eye bolts are to be left in place.

3.8 Lubricants, Grease Oil and Fuel

3.8.1 Provide the complete initial lubrication of all equipment in accordance with the manufacturer's recommendations. Provide a complete schedule of all manufacturer's recommended lubricants. Fill grease, oil and fuel tanks, as required for the initial operation of the equipment.

3.9 Small Piping

3.9.1 Supply and install all small connecting pipework, fittings and valves whether shown on the Contract Drawings or not. Perform all such work strictly in accordance with the instructions of the manufacturer whose equipment is being installed or connected.

3.10 Anchor Bolts

3.10.1 Unless otherwise specified, supply all stainless steel anchor bolts, such anchor bolts being of a diameter and size as recommended by the manufacturers of the equipment and machinery being installed. Generally, use expansive type anchorages in setting small equipment. Set large pumps by means of bolts with sleeves cast into the concrete to a minimum depth of 150 mm. Elsewhere, cast in place anchor bolts may be used subject to the approval of the Consultant; these must be properly positioned by means of substantial templates.

3.11 Pump and Equipment Bases

3.11.1 Provide concrete bases for the equipment identified on the Contract Drawings. Final setting of equipment bases shall be on cement grout placed on concrete bases, or as otherwise recommended by the equipment supplier. Grouting shall be in accordance with Section 03300 – Cast-in-Place Concrete. Provide anchor bolts for all bases. Finish vertical sides of pump bases and bases to match the adjacent floor.

3.11.2 The final shape and dimensions of bases and anchor bolt locations for the bases, where not already finalized, will be determined by the Consultant after receipt of the equipment manufacturer's detail drawings. In general, the concrete bases are to be a minimum of 100 mm larger than the supplied equipment base in each direction.

3.11.3 Reinforced concrete bases shall be firmly fixed to the parent concrete slab by adequate dowels as shown on the Contract Drawings or as recommended by the equipment supplier and approved by the Consultant.

3.12 Equipment Cabinet Bases

3.12.1 Install all floor-mounted cabinets on concrete bases whether shown on the Contract Drawings or not. Concrete shall be as specified in Section 03300 – Cast-in-Place Concrete.

3.12.2 Anchor bases as recommended by the manufacturer or as specified elsewhere in these Specifications.

3.12.3 Final shape and dimensions shall be determined by the Consultant after receipt of the equipment manufacturer's detail drawings.

3.13 Field Welding and Fabrication

3.13.1 Ascertain details of field welding and fabrication to be carried out for the erection and installation of the various items of equipment.

3.13.2 Fabricate the equipment in accordance with CSA Standard S16, Steel Structures for buildings and the manufacturer's instructions.

3.13.3 Have the welding shielded, conforming to CSA Standard W59.0, General Specifications.

3.14 Equipment Guards

3.14.1 Provide removable protective guards for all open rotating equipment including pulleys, belts, drives, shafts and couplings, etc.

3.14.2 Ascertain the extent of the work for the installation and/or the supply etc., of equipment guards by direct contact with the equipment suppliers.

3.15 Protection of Equipment

3.15.1 After the equipment has been installed and prior to final acceptance, protect the equipment from damage. Ensure that protection measures are to the satisfaction of the manufacturer and the Consultant.

3.16 Alignment

3.16.1 All rotating equipment is to be set and aligned in accordance with the more stringent requirements of either the equipment manufacturer's instructions or the following:

.1 Level base, use machinists level on all machined surfaces.

.2 Base is to be true and levelled.

.3 Alignment of shafts, soft foot or motor and couplings shall be performed by reverse dial, rim to rim and face to face. Soft foot will be rim to rim vertical and horizontal mode.

.1 Soft foot of motor shall be checked to be within a tolerance of 0.03 m.

.2 Shaft to be aligned within a tolerance of ± 0.025 mm to 0.070 mm.

.3 Piping strains to pump shall be within a tolerance of ± 0.025 mm to 0.070 mm.

.4 Provide the Consultant with an alignment report.

3.17 Vibration Monitoring

3.17.1 Without exception, all rotating equipment shall be checked and tested for vibration:

.1 The vibration level is to be within the specified limit as per the manufacturer's recommendations. (Generally, the peak vibration velocity shall not exceed 1 mm/sec measured in the filter-in mode). Measurement shall be carried out with a Real Time analyzer, Nicolet 100A. Provide a hard copy Vibration Signature Spectrum showing vibration velocities over a frequency range of 0 to 2000 Hz, measured in a filter-in mode.

.2 Provide the Consultant with the original Vibration Monitoring reports and all copies necessary for the Maintenance Data.

3.18 Testing and Commissioning

3.18.1 Unless otherwise specified, provide commissioning and start-up in accordance with the requirements of all related Specification Sections. The factory trained supervisor(s) must have a minimum of two years' experience with the firm.

3.18.2 Unless otherwise specified, furnish a certificate of final inspection and approvals from the electrical inspection authority to the Consultant.

3.19 Training

3.19.1 Unless otherwise specified, provide Training in accordance with Section 01820–Demonstration and Training.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 The scope of this section covers all equipment supplied under this Division.

1.2 Intent of Section

1.2.1 The intent of this section is to describe the requirements for the labelling and identification of equipment, piping, valving, and associated processes.

1.3 General

1.3.1 Identification to be in the English language.

1.3.2 For all equipment supplied under this Division provide lamicoid identification labels.

1.3.3 Labels shall be installed after all painting has been completed and shall be secured with self-tapping screws or adhesive.

1.3.4 Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Do not paint over nameplates and where apparatus is to be concealed. Attach the nameplate in an approved location on the equipment support or frame.

1.3.5 Identify all equipment with the corresponding remote controls and sensors.

1.3.6 Reference tag numbers as shown on drawings on all equipment.

1.3.7 Wording on nameplates and piping to be approved by Engineer prior to manufacture.

1.4 Reference Standards

1.4.1 All labelling colors shall be in accordance with the Recommended Standards for Waterworks – 2003, Guidelines for the Design Guidelines for Drinking Water Systems - 2008, MOECC, CSA and C.G.S.B. Standards.

1.4.2 Perform identification work in accordance with CGSB 24-GP-3A-67 and NFPA 20 except where specified otherwise.

1.4.3 Provide ULC and CSA registration plates, as required by respective agency.

1.5 Related Sections

1.5.1 DIVISION 1 – GENERAL REQUIREMENTS.

1.5.2 DIVISION 3 – CONCRETE.

1.5.3 DIVISION 5 – METALS.

1.5.4 DIVISION 9 – FINISHES.

1.5.5 DIVISION 11 – EQUIPMENT.

1.5.6 DIVISION 15 – MECHANICAL.

1.5.7 DIVISION 16 – ELECTRICAL.

1.6 Measurement and Payment

1.6.1 The Lump Sum in the Bid Form for “Identification and Labeling” of Equipment, Piping and Valves shall include all the provisions in this section.

1.7 Samples

1.7.1 Submit Samples in accordance with Section - 01330 - Submittal Procedures.

1.7.2 Submit samples and lists for all labels and tags for proposed wording for approval before engraving.

2 PRODUCTS

2.1 Manufacturer's Nameplates

2.1.1 Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.

2.1.2 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors, pump capacity and date of manufacture.

2.2 System Nameplates

2.2.1 Colour:

.1 Hazardous: red letters, white background

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

2.2.2 Sizes:

.1 Lamicoid 3 mm thick plastic engraving sheet, black face, white core, self-adhesive or white anodized aluminium, matte finish, square corners, letters accurately aligned, and machine engraved into core unless specified otherwise, or otherwise required by applicable codes.

.2 Conform to the following table:

Size No.	Dimensions (mm x mm)	No. of Lines	Letter Height (mm)
1	10x50	1	3
2	13x75	1	5
3	13x75	2	3
4	20x100	1	8
5	20x200	1	8
6	20x100	2	5
7	25x125	1	12
8	25x125	2	8
9	35x200	1	20

.3 Use average of 25 letters/numbers (maximum).

.4 Use Size No. 6 for terminal cabinets and control panels.

.5 Use Size No. 9 for equipment in mechanical rooms.

2.3 Motor Nameplate

2.3.1 All motors to be supplied with corrosion-resistant metal name plates giving the following information:

.1 Supply voltage (V), Full load current (A), Phase, Frequency (Hz), Power (kW), Service Factor, Rotations Per Minute/Rated Speed (RPM), Insulation class, Bearing numbers, Model number, and Serial number

2.4 Piping

2.4.1 Identification:

.1 To CGSB 24-GP-3a-67 unless specified elsewhere.

.2 Identify medium by lettered legend, classification by primary and secondary colours, and direction of flow by arrows.

2.4.2 Sizes:

.1 Provide flow direction arrows with labelling identifying liquid/gas conveyed. Use double headed arrows where flow is reversible.

.2 Legend: block capitals to following table:

Outside Diameter of Pipe or Insulation (mm)	Size of Letters (mm)
30	13
50 - 100	19
150	32

Outside Diameter of Pipe or Insulation (mm)	Size of Letters (mm)
> 150	50

.3 Primary Colours

.1 At valves and fittings: 500 mm long.

.2 Elsewhere: 1000 mm long.

.4 Secondary colour bands (including recirculation route): 50 mm wide, 75 mm in from one end of primary colour band).

.5 Arrows:

.1 Outside diameter of pipe/insulation 75 mm high and greater: 150 mm long x 50 mm high.

.2 Outside diameter of pipe/insulation less than 75 mm: 100 mm long x 50 mm high.

.3 Use double headed arrows where flow is reversible.

2.4.3 Material:

.1 Paint to CGSB 1-GP-60M

.2 Legend markers, arrows colour bands: plastic coated cloth material with protective overcoating and waterproof contact adhesive undercoating, suitable for 100 per cent RH and continuous operating temperature of 75°C and intermittent temperature of 100°C. Apply to prepared surfaces. Wrap tape around pipe or pipe covering with ends overlapping one pipe diameter.

.3 Waterproof and heat resistant plastic marker tags for pipes and tubing 20mm nominal and smaller.

.4 Acceptable material: W.H. Brady Inc., Seton Name Plate Corp.,

2.5 Controls and Identification

2.5.1 Identify all systems, equipment, components, controls, and sensors.

2.5.2 Inscription to identify function and Tag Number.

3 EXECUTION

3.1 Manufacturer's Nameplates

3.1.1 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

3.2 System Nameplates

3.2.1 Locations:

.1 In conspicuous location to facilitate easy reading from operating floor and to properly identify equipment and/or system.

.2 Provide stand-offs for nameplates on hot surfaces and insulated surfaces.

3.3 Piping

3.3.1 Locations of piping identification:

.1 On long straight runs in open areas of equipment rooms clearly visible from any one viewpoint in operating areas or walking isles maximum distance between labels is 5m.

.2 Adjacent to all changes in direction.

.3 On both sides of visual obstruction or where run is difficult to follow.

.4 Both sides where piping passes through walls, partitions, and floors.

.5 Label to be easily and accurately readable from usual operating areas and all readily accessible points.

.6 Plane of label to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour of label caused by dust and dirt and risk of physical damage.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers the installation of miscellaneous piping, miscellaneous steel, stainless steel, miscellaneous plastic, cast iron soil pipe, copper tubing, and accessories, located above grade or within building structures, including wall penetrations below grade to appoint 1.00 m beyond the exterior face of the structure, all as indicated on the drawings. Contractor shall furnish all necessary jointing materials, coatings, and accessories that are specified herein.

1.1.2 Pipe supports and anchors shall be furnished by Contractor and are covered in the pipe supports sections.

1.1.3 Refer to Section 05999 - Miscellaneous Metals for Steel or Stainless-Steel Work.

1.2 General

1.2.1 Materials installed under this section shall be installed in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the manufacturer, unless exceptions are noted by Engineer.

1.3 Submittals

1.3.1 Drawings and Data. Complete specifications, data, and catalogue cuts or drawings shall be submitted in accordance with the submittals section.

1.4 Quality Assurance

1.4.1 Tolerances. These tolerances apply to in-line items and connections for other lines.

.1 The general dimension, such as face-to-face, face or end-to-end, face- or end-to center, and center-to-center shall be 3 mm (1/8 inch).

.2 The inclination of flange face from true in any direction shall not exceed 4 mm per meter (3/64 inch per foot).

.3 Rotation of flange bolt holes shall not exceed 1.5 mm (1/16 inch).

1.5 Delivery, Storage, and Handling

1.5.1 Shipping shall be in accordance with the shipping section. Handling and storage shall be in accordance with the handling and storage section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

1.5.2 Plastic pipe, tubing, and fittings shall be stored between 4°C and 32°C (40°F and 90°F).

1.5.3 Coated Pipe. Handling methods and equipment used shall prevent damage to the protective coating and shall include the use of end hooks, padded calipers, and nylon or similar fabric slings with spreader bars. Bare cables, chains, or metal bars shall not be used. Coated

pipe shall be stored off the ground on wide, padded skids. Plastic-coated pipe shall be covered or otherwise protected from exposure to sunlight.

2 PRODUCTS

2.1 Service Conditions

2.1.1 Pipe, tubing, and fittings covered herein shall be installed in the services indicated in the various pipe sections.

2.1.2 Materials

Solder	Solid wire, ASTM B32, ANSI/NSF 61 certified, Alloy Grade Sb5, (95-5).
Soldering Flux	Paste type, ASTM B813.
Brazing Filler Metal	AWS A5.8, BCuP-5; Engelhard "Silvaloy 15", Goldsmith "GB-15", or Handy & Harman "Sil-Fos".
Brazing Flux	Paste type, Fed Spec O-F-499, Type B.
Insulating Fittings:	
Threaded	Dielectric steel pipe nipple, ASTM A53, Schedule 40, polypropylene lined, zinc plated; Perfection Corp. “Clearflow Fittings”.
Flanged	Epco “Dielectric Flange Unions” or Central Plastics “Insulating Flange Unions”.
Pipe Insulation	See Section 11902
Watertight/Dust tight Pipe Sleeves	O-Z Electrical Manufacturing “Thruwall” and “Floor Seals”, or Thunderline “Link-Seals”; with modular rubber sealing elements, 2on-metallic pressure plates, and galvanized bolts.
Pipe Sleeve Sealant	Polysulfide or urethane, as specified in the Section 7900, Sealants
Anti-Seize Thread Lubricant	Jet-Lube “Nikal”, John Crane “Thred Gard Nickel”, Never-Seez “Pure Nickel Special”, or Permatex “Nickel Anti-Seize”.
Teflon Thread Sealer	Paste type; Hercules “Real-tuff”, John Crane “JC-30”, or Permatex “Thread Sealant with Teflon”.
Teflon Thread Tape	Hercules “Tape Dope” or John Crane “Thread-Tape”.
Solvent Cement:	
PVC Systems	ASTM D2564.
CPVC Systems	ASTM F493.
Primer, PVC Systems	ASTM F656.
Protective Coatings:	
Tape Wrap	ANSI/AWWA C209, except single ply tape thickness shall not be less than 30 mils [760 µm]; Protecto Wrap "200" or Tapecoat "CT".
Primer	As recommended by the tape manufacturer.
Coal Tar Coating	Medium consistency; Carboline "Bitumastic Super Service Black" or Tnemec "46-465 H.B. Tnemecol".

3 EXECUTION

3.1 Inspection

3.1.1 All piping components shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and recleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3.2 Preparation

3.2.1 Field Measurement. Pipe shall be cut to measurements taken at the site, not from the drawings. All necessary provisions shall be made in laying out piping to allow for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction to avoid transmission of noise resulting from expansion.

3.3 Installation

3.3.1 General. All instruments and specialty items shall be installed according to the manufacturer's instructions and with sufficient clearance and access for ease of operation and maintenance.

.1 Flat faced wrenches and vises shall be used for copper tubing systems. Pipe wrenches and vises with toothed jaws will damage copper materials and shall not be used. Bends in soft temper tubing shall be shaped with bending tools.

3.3.2 Pipe Sleeves. Piping passing through concrete or masonry shall be installed through sleeves that have been installed before the concrete is placed or when masonry is laid. Pipe sleeves installed through floors with a special finish, such as ceramic or vinyl composition tile, shall be flush with the finished floor surface and shall be provided with nickel or chromium plated floor plates. Unless otherwise indicated on the drawings, in all other locations where pipes pass through floors, pipe sleeves shall project not less than 25 mm [1 inch] nor more than 50 mm [2 inches] above the floor surface, with the projections uniform within each area. In the case of insulated pipes, the insulation shall extend through pipe sleeves. Where the drawings indicate future installation of pipe, sleeves fitted with suitable plastic caps or plugs shall be provided.

.1 Holes drilled with a suitable rotary drill will be considered instead of sleeves for piping which passes through interior walls and through floors with a special finish.

.2 Unless otherwise indicated on the drawings, all pipes passing through walls or slabs which have one side in contact with earth or exposed to the weather shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies, or with sleeves and modular rubber sealing elements.

.3 Piping passing through locations as required shall be made dust tight and gastight with special rubber-gasketed sleeve and joint assemblies; with sleeves sealed with modular rubber sealing elements; or by caulking with oakum and polysulfide or urethane sealant.

3.3.3 Pipe Joints. Pipe joints shall be carefully and neatly made in accordance with the indicated requirements.

.1 Threaded. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs.

.1 Threaded joints in plastic piping shall be made up with teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with teflon thread sealer and teflon thread tape applied to all male threads.

.2 Threaded joints in steel piping for chlorine service shall be made up with teflon thread tape or litharge and glycerine paste applied to all male threads.

.3 At the option of Contractor, threaded joints in other piping may be made up with teflon thread tape, thread sealer, or a suitable joint compound.

3.3.4 Compression. Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1 1/4 turns and not more than 1 1/2 turns past fingertight, or as recommended by the fitting manufacturer, to produce a leaktight, torque free connection.

3.3.5 Soldered and Brazed. Where solder fittings are specified for lines smaller than 50 mm [2 inches], joints may be soldered or brazed at the option of Contractor. Joints in 50 mm (2 inch) and larger copper tubing shall be brazed. Joints in copper chlorine tubing and refrigerant piping shall be brazed; solder will not be acceptable. Brazing alloy shall contain no tin.

.1 Surfaces to be joined shall be thoroughly cleaned with flint paper and coated with a thin film of flux. At each joint, tubing shall enter to the full depth of the fitting socket.

.2 Care shall be taken to avoid overheating the metal or flux. Each joint shall be uniformly heated to the extent that filler metal will melt on contact. While the joint is still hot, surplus filler metal and flux shall be removed with a rag or brush.

3.3.6 Solvent Welded. Solvent welded connections shall only be used for PVC or CPVC pipe. All joint preparation, cutting, and jointing procedures shall comply with the pipe manufacturer's recommendations and ASTM D2855. Pipe ends shall be beveled or chamfered to the dimensions recommended by the manufacturer. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the setting time recommended by the manufacturer. Pressure testing of solvent welded piping systems shall not be performed until the applicable curing time, as set forth in Table X2.1 of ASTM D2855, has elapsed.

3.3.7 Flanged. Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but shall not be torqued less than the minimum value required by the gasket manufacturer. Flange bolts shall not be so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly.

.1 Flange bolt holes shall be oriented as follows, unless otherwise indicated on the spool drawings:

.1 Vertical flange face: Bolt holes to straddle the vertical centerlines.

.2 Horizontal flange face: Bolt holes to straddle plant north-south centerlines.

.2 Pipe sealants, thread compounds, or other coatings shall not be applied to flange gaskets unless recommended by the gasket manufacturer for the specified service and approved by Engineer.

.3 Welds at orifice flanges shall have internal surfaces ground smooth to the pipe wall.

.4 Slip-on flanges shall be welded inside and outside. There shall be a distance of approximately 1.5 to 3 mm (1/16 to 1/8 inch) between the edge of the fillet weld and the face of the flange. The seal weld shall be applied so that the flange face shall be free of weld spatter and does not require refacing.

.5 Flat-faced flanges shall be used when mating to Class 125 flanges. Full face gaskets shall be used with flat-faced flanges and ring gaskets shall be used with raised faced flanges.

.6 Weld neck flanges shall be used with butt-weld fittings. The bore of weld neck flanges shall match the pipe wall thickness.

.7 Insulating joints connecting submerged (buried) piping to exposed piping shall be installed above the maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive-bonded concrete anchors. All submerged (buried) metallic piping shall be isolated from the concrete reinforcement. Insulating flanges shall be tested for electrical isolation after installation and bolt-up but prior to introduction of conducting fluid.

3.3.8 Welded. Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI B31.1.

.1 Weld cross-sections shall be equal to or greater than the pipe wall thickness. Welds shall be smooth and continuous and shall have interior projections no greater than 1.5 mm [1/16 inch]. Backing strips or rings shall not be used except with specific prior review by Engineer as to use, material, and design. Root gap inserts that are completely melted and consumed in the weld bead are acceptable only when reviewed in advance by Engineer.

.2 Stainless steel welding shall be inert gas tungsten arc (TIG) or the direct current, straight polarity, inert gas metal arc process (MIG).

3.3.9 Grooved Couplings. Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform to flexible grooving dimensions, as set forth in AWWA C606, and shall be clean and sharp without burrs or check marks.

3.3.10 Push on. Gasket installation and other jointing procedures shall be in accordance with the recommendations of the manufacturer. Each spigot end shall be suitably beveled to facilitate assembly. All joint surfaces shall be lubricated with a heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean.

3.3.11 Rubber-Gasketed. Rubber-gasketed joints for hub and spigot type cast iron soil pipe shall have plain spigot ends, without beads. Cut ends of all pipe shall be cut square, beveled, and all burrs shall be removed. Spigot ends shall be coated with a lubricant recommended by the gasket manufacturer and fully seated in the gasket. Clamps for hubless cast iron soil pipe shall be installed in accordance with the manufacturer's recommendations.

3.3.12 Pipe. Pipe shall be installed as specified, as indicated on the drawings, or, in the absence of detail piping arrangement, in a manner acceptable to Engineer.

.1 Piping shall be installed without springing or forcing the pipe in a manner which would induce stresses in the pipe, valves, or connecting equipment.

.2 Piping shall be supported in conformance with Section 11190 Pipe and Valve Supports section.

.3 Piping shall be connected to equipment by flanges or unions as specified in the pipe procurement sections. Piping connecting to equipment shall be supported by a pipe support and not by the equipment.

.4 A union shall be provided within 600 mm (2 feet) of each threaded-end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping adjacent to devices or equipment which may require removal in the future and where required by the drawings or the specifications.

.5 Water supply piping within structures shall be arranged, and facilities provided, for complete drainage. All piping serving metering equipment shall be uniformly graded so that air traps are eliminated, and complete venting is provided.

.6 Taps for pressure gauge connections on the suction and discharge of pumping units shall be provided with a nipple and a ball type shutoff valve.

.7 Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.

.8 In all piping except air and gas piping, insulating fittings shall be provided to prevent contact of dissimilar metals, including but not limited to, contact of copper, brass, or bronze pipe, tubing, fittings, valves, or appurtenances, or stainless-steel pipe, tubing, fittings, valves, or appurtenances with iron or steel pipe, fittings, valves, or appurtenances. Insulating fittings shall also be provided to prevent contact of copper, brass, or bronze pipe, tubing, fittings, valves or appurtenances with stainless steel pipe, tubing, fittings, valves, or appurtenances.

.9 Buried PVC piping shall be "snaked" in the trench and shall be kept as cool as possible during installation. PVC pipe shall be kept shaded and shall be covered with backfill immediately after installation.

.10 Piping adjacent to flow sensors shall be installed in accordance with the requirements of the manufacturer of the flow sensor and commonly accepted design practices of the appropriate straight pipe runs both upstream and downstream.

.11 Vents at all high points and drains at all low points in the piping that are required for complete draining for pressure test may not be shown on these drawings. Contractor

shall add such items as found to be necessary during detail piping design and/or piping installation.

3.3.13 Valves. Prior to soldering or brazing valves, teflon and elastomer seats and seals shall be removed to prevent damage.

.1 Isolation valves provided with equipment and instruments shall be located in a manner which will allow ease of access and removal of the items to be isolated.

3.4 Piping Assembly

3.4.1 General. Contractor shall only use labour that has been qualified by training and experience to capably perform the specified activities required to accomplish the work in a satisfactory manner

.1 If there is a conflict between the mechanical drawings and piping and instrumentation drawings (P&IDs), the P&ID shall take precedence. Any deviations from the Specifications or piping locations shown on the drawings require prior review and approval by Engineer.

3.4.2 Buttwelded Piping. The specification and qualification of weld joints and welders for buttwelded piping shall be in accordance with ASME Boiler Pressure Vessel Code, Section IX, Welding and Brazing. Weld procedure specifications (WPS) and procedure qualification reports (PQR) shall be submitted to Engineer for review and validation of joint design, efficiencies and strength before installation begins.

.1 Non-destructive examination (NDE) shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section V, Non-destructive Examination. The minimum level of NDE shall be as follows:

.1 100 percent visual examination of welds by a qualified examiner (per ASME B31.1).

.2 Radiographic testing (RT) of 5 percent random sampling of welds.

.2 If the Contractor wants to use alternative techniques or intends to apply alternative methods considered equivalent to those indicated herein, a proposal on such techniques or methods shall be submitted in writing to Engineer for review and approval at least 14 days before intended date of use.

.3 Welding shall not begin until weld joint and welder qualification submittals have been reviewed and approved. NDE shall be performed before the pressure and leakage testing of the piping. Weld acceptance standards shall be in accordance with ASME B31.1, Chapter VI. If a weld fails the NDE, it shall be repaired, and the test repeated at no additional cost to the Owner.

3.5 Protective Coating

3.5.1 Standard weight and extra strong black steel pipe in buried locations will have exterior surfaces protected with a shop applied plastic coating.

3.5.2 The exterior surfaces of all fittings, couplings, specials, and other portions of buried piping not protected with plastic coating shall be tape-wrapped in the field. All surfaces to be

tape-wrapped shall be thoroughly cleaned and primed in accordance with the tape manufacturer's recommendations immediately before wrapping. The tape shall be applied by two ply (half lap) wrapping or as needed to provide a total installed tape thickness of at least 60 mils [1.5 mm]. Joints in plastic coated pipe shall be cleaned, primed, and tape-wrapped after installation.

3.5.3 Inspection. All shop applied plastic coatings and tape wrap on pipe or fittings shall be inspected for holidays and other defects after receipt of the pipe or fitting on the job and immediately before installation. Inspection of plastic coatings after installation of the pipe or fitting in the trench shall be made where, in the opinion of Engineer, the coating may have been damaged during installation. Holidays and defects disclosed by inspection shall be repaired in accordance with the recommendations of the coating or tape wrap manufacturer, as applicable.

.1 The inspection shall be made using an electrical holiday detector. The detector and inspection procedures shall conform to the requirements of Section 4.4 of ANSI/AWWA C209.

3.6 Cleaning

3.6.1 The interior of all pipe, valves, and fittings shall be smooth, clean, and free of blisters, loose mill scale, sand, dirt, and other foreign matter when installed. Before being placed in service, the interior of all lines shall be thoroughly cleaned, to the satisfaction of Engineer.

3.7 Acceptance

3.7.1 OWNER reserves the right to have any section of the piping system which he suspects may be faulty cut out of the system by Contractor for inspection and testing. Should the joint prove to be sound, Owner will reimburse Contractor on a time and material basis as specified in the Contract. Should the joint prove to be faulty, the destructive test will continue joint by joint in all directions until sound joints are found. Costs for replacement of faulty work and/or materials shall be the responsibility of Contractor.

END OF SECTION

1 GENERAL

1.1 Intention of Section

1.1.1 This section covers the supply, delivery, and supervision of installation and commissioning of process valves, piping and fittings.

1.1.1 The term "Process Piping" includes pipes within or outside structures., used to convey potable water or air.

1.1.2 These systems are included in other sections of the Specifications.

1.1.3 The plans and specifications are intended to set the acceptable minimum and shall not be construed to relieve this Contractor of the responsibility of:

.1 Installing a complete, trouble-free system

.2 Good workmanship

1.1.4 All materials, coatings and lubricants shall be suitable for use with potable water.

1.2 References

1.2.1 ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.

1.2.2 ANSI B16.5, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.

1.2.3 ANSI B16.20, Ring-Joint Gaskets and Grooves for Steel Pipe Flanges.

1.2.4 ANSI B18.2.1, Square and Hex Bolts and Screws.

1.2.5 ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

1.2.6 ASTM A47M, Specification for Ferritic Malleable iron Castings.

1.2.7 ASTM A536, Specification for Ductile Iron Castings.

1.2.8 ASTM A120, Specification for Pipe, Steel, Black, and Hot-Dipped Zinc Coated, (Galvanized) Welded and Seamless, for Ordinary uses.

1.2.9 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

1.2.10 CSA B242, Groove and Shoulder type Mechanical Pipe Couplings.

1.2.11 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

1.2.12 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

1.2.13 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.

1.2.14 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.2.15 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2.16 ANSI 150, ASTM D-1784, all PVC valves with classification 12454A.

1.2.17 AWWA C500, Metal Seated Gate Valves for Water Supply Service

1.2.18 AWWA C504, Rubber Seated Butterfly Valves.

1.2.19 AWWA C508, Swing Check Valves for Waterworks Service, 2 in. to 24 in. NPS

1.2.20 AWWA C509, Resilient Seated Gate Valves for Water Supply Service.

1.2.21 AWWA C510, Double Check Valve, Backflow Preventer Assembly.

1.2.22 AWWA C511, Reduced Pressure Principle Backflow Prevention Assembly.

1.2.23 AWWA C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

1.2.24 AWWA C542, Electric Motor Actuators for Valves and Slide Gates.

1.2.25 AWWA C550, Protective Epoxy Interior Coatings for Valves and Hydrants

1.2.26 AWWA C606, Grooved and Shouldered Joints

1.2.27 AWWA C800, Underground Service Line Valves and Fittings

1.3 Operating Conditions

1.3.1 The following site operating, and water quality conditions shall be assumed for all design calculations:

.1 40°C maximum/5°C minimum ambient air temperature

.2 20°C maximum/1°C minimum water temperature

.3 95% maximum relative humidity (non-condensing)

.4 7.5 - 9 water pH

.5 elevation ±180 meters above sea level

.6 Water will contain nominal chlorine residual at 1 to 2 mg/L.

.7 Disinfection of piping and valves prior start-up in this project and prior start-up of other possible future upgrade projects would require chlorine concentrations from 50 mg/L to 200 mg/L according to AWWA C653 procedures.

.1 Refer to the Contract Drawings for further details.

1.4 Shop Drawings

1.4.1 Submit Shop Drawings, Samples and catalogue data to the Consultant for approval.

1.4.2 The shop drawing submission shall include, but not be limited to, the following:

.1 General dimensioned layout and materials list for all valves.

.2 Valve list showing valve torque requirements corresponding motorized operator torque capability

.3 Summary list showing valve tag numbers, size type of operator, valve class, location, motorized operator number, pipe system including pipe schedule, materials.

.4 Submit Manufacturer's catalogue literature indicating the bends, couplings, cocks, fittings, pipes, gaskets and other required materials.

.5 Grooved joint couplings and fitting shall be referred to on drawings and product submittals and be identified by the manufacturer's listed model or series designation.

.6 Descriptive material in sufficient detail to show the general construction pertinent to the proper review.

.7 The Supplier shall indicate a list of spare parts, which would be recommended to purchase and individual prices for each item.

.8 All ancillary equipment to be provided by the Supplier shall be listed.

.9 Special accessories or tools for the adjustment or removal of parts required for any piece of equipment shall be listed and furnished as part of the supply.

1.4.3 Fabrication shall not commence until review of these drawings and data has been completed.

1.4.4 Provide maintenance data for incorporation into maintenance manual specified in Section 01780 - Closeout Submittals.

1.5 Measurement and Payment

1.5.1 Work outlined in this section is included in the lump sum tender price

1.6 Shipment, Protection and Storage

1.6.1 Deliver valves and fittings to site using loading methods, which do not damage casings or coatings.

1.6.2 Clearly tag valves stating size, type, coatings, and mating parts.

1.6.3 Store on-site and inside protected from weather until ready for incorporation in the work using methods recommended by the manufacturer to prevent damage, undue stresses, or weathering.

2 PRODUCTS

2.1 Pipe - General

2.1.1 Supply all pipes and fittings of the materials, size, classes and types as shown on the Contract Drawings and as specified herein.

2.1.2 New pipelines shall be concrete encased if the lines are located below any structures or buildings. The dimension shall be twice as much as the pipe diameter.

2.1.3 As the Contract Drawings may not present flange or coupling connections except for expansion joints, the Contractor shall determine the location of flange or coupling connections. Submit the shop drawing to present the connection type and locations.

2.1.4 The Contractor shall have the coupling and pipe suppliers review the entire pipeline and configuration with pipe supports and submit its review for the Engineer's approval. As per the coupling and pipe suppliers' recommendations, the pipe support locations and coupling/expansion joint type may be changed, but no extra cost to the Owner shall be permitted.

2.1.5 The Contractor shall install piping and valves as per P&IDs if the Process Design Drawings do not present any installation details or connections. No extra cost to the Owner shall be permitted.

2.1.6 Underground burial sections of piping and fittings shall be protected with Denso paste, Profiling Mastic and wrapped with Denso LT Tape in accordance with manufacturer's requirements.

2.2 Piping and Tubing

2.2.1 For all piping, tubing and accessories, design for operating pressures appropriate to the system at given locations. Select appropriate pipe classes and pressure/vacuum ratings.

2.2.2 Pipe shall be designed for 520 kPa (75 psi) working pressure including any additional allowances for transient/surge pressures. Pipe design and reinforcement shall be provided in accordance with AWWA standards.

2.3 Stainless Steel Piping and Fittings

2.3.1 The stainless steel pipe and fittings to be applied to water main shall be Type 316L stainless steel ASTM A312, conforming to ANSI B36.19, Schedule 10S.

2.3.2 The wall thickness of piping system (including tees, elbows, flanges, lateral fittings, specials, couplings, etc.) shall be designed to withstand full vacuum and a working pressure of 520 kPa at 100°C. The pipe shall be carefully die-formed or rolled true to dimension and round within a tolerance plus or minus 1.5 mm. Ends of the pipe and fittings are to be perpendicular to the longitudinal axis.

2.3.3 All joints shall be welded by either Tungsten Inert Gas or Metal Inert Gas method. Pipe surfaces shall be smooth and even and the interior weld bead shall not be higher than 1.5 mm. The pipes shall be pickled by immersion in acid bath for removal of weld discoloration and iron pick-up. After pickling, the pipe and fittings shall be thoroughly washed with fresh clean water. All pipes shall be properly secured for shipment and marked in the shop for

identification at job site. The exterior finish of the pipework shall be in accordance with the Manufacturer's recommendation unless otherwise noted herein.

2.3.4 Flanges for all pipe sizes - rolled type Van-Stones or rolled angle, thickness not less than thickness of pipe, with galvanized mild steel backing flanges to ANSI B16.5 Class 150 or Class 300. Place true and perpendicular to the axis. Fasten with bolts and nuts. Gaskets - 5 mm thick red rubber, cloth insert, full faced.

2.3.5 All grooved couplings and fittings shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

2.3.6 After the piping system has been installed and tested, the Contractor shall pickle wash the stainless steel piping system to remove weld discoloration and iron pickup. After pickling, the pipe and fittings shall be thoroughly washed with fresh clean water and inspected by the Engineer if deemed necessary by the Engineer, the Contractor may be instructed to repeat the entire pickle wash procedure.

2.3.7 Pipe couplings shall be provided as deemed necessary for expansion and/or maintenance purposes. Apply flexible coupling and fittings to the expansion loops to absorb thermal expansion/contraction within the couplings at the elbows.

2.3.8 Main anchors shall be installed at terminal points, major branch connections or changes of piping direction. Use anchors to direct movement away from or to protect critical changes in direction, bend, branch connections and structure. Spacing and types of supports shall be considered in accommodating anticipated axial movements.

2.3.9 The expansion joint design for all piping shall be provided by the Contractor. Submit shop drawings stamped by a Professional Engineer for the Engineer's review.

2.3.10 Provide 316L SS couplings, joints and other components where possible if the pipe material is of SS316L. Otherwise, provide epoxy coated components. Provide NSF 61 approved gaskets and 316L SS hardware.

2.3.11 Victaulic Style couplings shall be provided as shown in Contract Drawings.

2.3.12 Stainless steel bolts and nuts shall be used for flange connection between dissimilar material pipes.

2.3.13 The use of stainless steel piping is subject to the following:

.1 That all welding be done by certified welders.

.2 That the alignment of welds be true to prevent any bending stresses in the welds from the pipe joining.

.3 That minimum welding work is performed in the field.

.4 That shop drawings for the various pipe work systems are submitted for review.

.5 That all necessary joints shown on the Contract Drawings be included or as determined by the Engineer.

2.4 Drainage Pipe and Fittings

2.4.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

.1 Local and district by-laws, regulations and published engineering standards.

.2 The Ontario Building Code which includes Part 7 Plumbing.

2.4.2 Schedule 40 solvent weld rigid PVC drain, waste and vent pipe and fittings in accordance with CSA B181.2. PVC injection moulded fittings, solvent weld type ends.

2.5 Fasteners

2.5.1 Studs, nuts, and washers shall be best quality Type 304 stainless steel ASTM A193 Grade B-8, Class 2.

2.6 Stainless Steel Tubing

2.6.1 Stainless steel tubing shall be used for all process water piping unless otherwise shown on the drawings. The following piping systems shall be from stainless steel tubing:

.1 Instrumentation connections and sample lines.

.2 Water piping less than 50mm shown on the process drawings (samples, isolation piping of air release).

2.6.2 Stainless steel tubing shall be fully annealed Type 316 seamless hydraulic tubing to ASTM A269, A213 or equivalent. Tubing to be free of scratches and suitable for bending and flaring. Joints shall be made with Swagelock stainless steel compression fittings or reviewed equivalent as supplied by Avon Valve and Fitting Limited, Scarborough. Fittings must withstand a working pressure same as pipes, without leakage.

2.7 Interior Finishes

2.7.1 General

.1 Provide products with factory applied coatings and finishes unless otherwise noted. Fittings and pipe of any one pipe system to be lined by the same manufacturer.

.2 Do not shop coat the internal surface of stainless steel or plastic piping.

.3 Provide standard mill finish for stainless steel pipe.

.4 Unless otherwise specified, finish fittings in the same manner as the pipe run.

2.8 Flanges

2.8.1 General requirements for flanges are as follows:

.1 Compatible flanges for mating to equipment or valves.

2.8.2 Do not use slip-on flanges that are attached to a pipe by means of set screws and gaskets (uni-flange, etc.).

2.9 Gaskets

2.9.1 For flat faced flanges, use full-face gaskets. For raised-face flanges, use ring type gaskets. Conform to ASTM B16.21 and NSF60/61 for use in potable water systems.

2.9.2 Use gasket materials for flanged connections suitable for the temperature, pressure, and corrosiveness of the fluid conveyed in the pipeline.

2.9.3 Unless otherwise specified, minimum Gasket Material Thickness for full face gaskets:

.1 Greater than 75 mm pipe diameter, 3.2 mm thick.

2.10 Piping Schedule

2.10.1 The Pipe Schedule is included to assist the Tenderer. The schedule does not purport to be fully complete and the Tenderer is to refer to the Contract.

2.10.2 Process piping schedule is provided in the following table:

Service	Nominal Sizes (mm)	Exposure	Pipe Material	Operating Pressure (kPa)	Working Temp (ºC)	Test Pressure (kPa)	PVC Insulation
LLPS Process Piping	150 250 300	Exposed	316L SS	500	0 - 25	750	No Insulation
Raw Watermain	300	Buried	PVC	500	0 - 25	750	No Insulation
Sampling Line	25	Exposed/ Buried	HDPE	200	0 - 25	300	No Insulation
Note: For pressure test, H = hydraulic test; P = pneumatic test.							

2.11 Valves

2.11.1 All potable water valves to be ANSI/NSF61 and NSF 372 approved and labelled.

2.11.2 All lubricants, epoxies, grease, etc. to conform to ANSI/NSF61.

2.11.3 Where there is an applicable AWWA recommended standard for the design, construction, and testing of a valve and/or actuator, equipment supplied under this section shall meet this standard in all regards unless otherwise specified herein. Where specifically requested, provide certificates of compliance with the applicable standards.

2.11.4 All valves 75mm or greater must have flanges as specified for the line into which they are to be installed, unless otherwise indicated by the Contract Drawings.

2.11.5 Ensure each valve and operator is of suitable construction and rating for the long-term service with the fluid being conveyed and at the pressure and operating frequencies required by the relevant service.

2.11.6 Maximum required pull on a manual operator to open or close the valve must not exceed 356 N (80 lb force) as per AWWA C504. Manual operators must operate in a clockwise motion to close the valve.

2.11.7 Unless specified otherwise, supply all ferrous metal valves with a protective interior epoxy coating conforming to AWWA Standard C550 for Protective Interior Coatings for Valves and Hydrants and certified by the National Sanitation Foundation (NSF) to Standard 61. Provide the following additional information as identified in AWWA C550.

.1 Affidavit of compliance.

.2 Measurement of coating thickness.

.3 Acceptable Coating Material: Carboline 891, or as approved.

.1 Coating Application: 2 coats, 6 mils minimum dry film thickness per coat to manufacturer's instructions.

2.11.8 Mark valves with size, pressure rating and manufacturer on a corrosion resistant nameplate mounted on the body.

2.11.9 Equip valves with a disc position indicator and a direction of flow indicator.

2.11.10 Provide tee wrench of steel pipe and tubing with socket for 50 mm square operating nut.

2.11.11 Operators must be capable of seating and unseating the valves and gates under the specified Design Water, Oil, Gas (WOG) pressure or unbalanced head.

2.11.12 The Surge Relief Valve shall be Model 106-RPS-RR, supplied by Singer Vales, or approved equivalent.

.1 The selected Surge Relief Valve shall be appropriate for the ultimate design flow of 6,800 m^3/day. The control pilot shall be initially set for a flowrate of 3,400 m^3/day.

2.12 Valve Schedule

2.12.1 The Valve Schedule is included to assist the Tenderer. The schedule does not purport to be fully complete and the Tenderer is to refer to the Contract.

2.12.2 The Valve Schedule is provided in Section 11101-S1.

2.13 Valve Operators

2.13.1 General

.1 All valves shall be equipped with operators.

.2 The valve operator types, as specified herein, describe only the general characteristics of the operator.

.3 The operator shall be compatible with the valve with which it will be used and shall be of the same manufacturer, or a product that is recommended by the valve manufacturer.

.4 The operator shall be sized to operate the valve for the full range of pressures and velocities imposed by the service.

.5 All valve operators shall be opened by turning counter-clockwise

2.13.2 Manual Operators:

.1 Manual handwheel operators shall be provided unless otherwise shown or specified. Ferrous handwheels shall be galvanized and painted the same colour as the valve and associated pipeline. Lever operators may be supplied on quarter-turn type valves 100mm and smaller, if recommended by the manufacturer; however, operator force shall not exceed initial breakaway.

.2 When the maximum force required to operate a valve under full operating head exceeds 175N (40 pounds), gear reduction operations shall be provided. Gear operators shall be totally enclosed and lubricated.

.3 On quarter-turn valves, the valve operators shall be of the self-locking type to prevent the disc or plug from creeping and shall be provided with position indicators to show the position of the valve disc or plug. Operators of the worm and gear type shall have self-locking worm gears, one-piece design, of bronze material, and accurately machine cut. The worm shall be hardened alloy steel, with thread ground and polished. Operators of the geared travelling nut type shall have threaded steel reach rods with an internally threaded bronze or ductile iron nut and equipped with adjustable stops.

.4 Valves located more than 1.8m (6 feet) above finish floor elevation shall be fitted with chain wheels and guides. Chain wheels and guides shall be galvanized or cadmium-plated. Chains shall be of the size recommended by the valve manufacturer and shall extend to within 1.2m (4 feet) of the operating floor. Where chains hang in normally travelled areas, appropriate "L" type tie-back anchors shall be provided and located as approved by the Engineer.Level type operators shall have some means of being fixed in any given position to prevent accidental movement; shall be of rugged, noncorrosive construction; and shall be fully compatible with the valve.

.5 Provide sufficient lubrication of all bearing gears and other moving parts. Lubricants shall be suitable for potable water.

.6 Cast an arrow with the word "OPEN" in a prominent location, readily visible to the operator, indicating the correct rotation of the handwheel to open (clockwise).

.7 Provide properly sized handwheels to suit the size of the valve, having a diameter of not less than 250 mm in diameter. Provide larger handwheels on valves greater than 1050 mm in diameter.

.8 Provide operators designed to withstand a force of up to 4000 N on the rim without damage.

.9 Provide carbon steel epoxy coated valve stem extension where additional clearance is required for pipe insulation, where valve operation without the extension is difficult, and in manholes.

.10 All stem extensions are sized for the maximum valve operating torque and deflection calculated to at less than 0.75 degrees.

2.13.3 Electrical Actuators:

.1 Refer to Section 11290 - Valve and Gate Actuators.

2.14 Butterfly Valves

2.14.1 Supply and install all butterfly valves as shown on the drawings and/or as specified herein.

2.14.2 Butterfly valves shall be of the short body rubber seated type, confirming to the latest revision of AWWA C504. Valves shall be bubble tight at the rated pressure and shall be suitable for both throttling and on/off isolation service. Provide an affidavit of compliance with applicable provisions of AWWA Standard C504 and with the supplementary specifications of this section.

2.14.3 Design butterfly valves for installation in any orientation and with valve stem either horizontal or vertical.

2.14.4 Shop Testing: Certified copies of reports describing the procedures and results of the performance test, leakage test and hydrostatic test for each unit must be submitted to the Consultant.

2.14.5 Provide butterfly valves manufactured to AWWA C504 - Class 150B Standards.

2.14.6 Valve body shall be of ductile iron construction, ASTM A536 Gr. 65-45-12.

2.14.7 Valve discs shall be of ductile iron, ASTM A536, Gr. 65-45-12.

2.14.8 Valve shall be rated for bi-directional shutoff up to 1034 kPa (150 psi).

2.14.9 Valve shafts shall be of solid 304 stainless steel corresponding to the design requirements of the latest revision of AWWA C504. The shafts shall be fastened to the disc by stainless steel designed to provide vibration-proof connection.

2.14.10 Seats and shaft packing shall be of Buna-N. Design valve seats to provide tight shut off at a pressure differential across the valve equal to the rated pressure. Valve seats can be installed on the body or on the disc. For valve sizes 600mm and larger, valve seats shall be adjustable as per AWWA C504 standards. The mating seat surface to be of ANSI 304 or 316 stainless steel. Valve seats must be suitable for end of line installation. Alternately, provide retaining flanges.

2.14.11 Shaft bearings shall be of the self-lubricating corrosion resistant sleeve type designed for both horizontal and vertical shaft loading.

2.14.12 Valve ends must have flanged ends conforming in dimension to ANSI B16.5, Class 150 ductile iron flanges and must be flat faced.

2.14.13 Valves shall be hydrostatically tested for bubble tight shutoff in accordance with the latest revision of AWWA C504.

2.14.14 Interior and exterior surfaces of all butterfly valves shall be fusion bonded epoxy coating or two-part liquid epoxy coating meeting NSF 61.

2.14.15 Unless otherwise indicated, valves shall be provided with handwheel operated manual gear actuators suitably selected for the torque requirements outlined in Table 4 of AWWA C504.

2.14.16 Provide gear ratios in the operator so that the force exerted on the rim of the wheel does not exceed 356 N as per AWWA C504 except for seating and unseating the butterfly valve

2.14.17 Acceptable Suppliers

.1 Val-Matic

.2 DeZurik

.3 Pratt

2.15 Rubber Flapper Check Valve

2.15.1 Supply and install rubber flapper check valves as shown on the drawings and/or as specified herein. The sizes and locations are as shown on the Contract Drawings.

2.15.2 Design valves in accordance with the following:

.1 Swing type, full body flanged type with a full size domed access cover and flexible disc.

.2 Designed, manufactured and tested in accordance with AWWA/ANSI C508.

.3 The valve shall be suitable for cold working pressure of up to 1034 kPa (150 psi).

.4 Body and cover - ductile iron (ASTM A536 Gr. 65 45 12) with removable top maintenance flange (gasketed or O ringed).

.5 Disc - steel coated hinge pin/disc with single moulded memory return Buna N (ASTM D2000-BG), hinge portion of disc nylon reinforced and warranted for 25 years, full flow area, and low head loss.

.6 Fusion bonded epoxy coating or two-part epoxy coating lined interior and exterior meeting NSF61, removable threaded plug at invert and on top of bonnet (to add indicators, limit switches or backflow device at a later date if required).

.7 Mechanical indicator shall be provided to continuous contact with the disc to ensure accurate disc position indication.

.8 Limit switch:

.1 Mechanical type limit switch to be activated by the external position indicator.

.2 Refer to Section 13100 Control & Instrumentation for details.

.9 Ends - ANSI B16.5 Class 150 Ductile Iron flanges.

.10 The valve shall be NSF 61 and NSF 372 for drinking water application.

2.15.3 Hydrostatically tested in the factory at 2 times their rated pressure. Conduct a seat closure test at the valve to demonstrate zero leakage.

2.15.4 Acceptable manufacturers

.1 Val-Matic, Swing-Flex

.2 Pratt, RD

.3 APCO, Series 100

2.16 Silent Globe Check Valve

2.16.1 Supply and install silent globe check valves as shown on the drawings and/or as specified herein. The sizes and locations are as shown on the Contract Drawings.

2.16.2 The Silent Globe Check Valve shall be of the silent operating type that begins to close as the forward flow diminishes and fully closes at zero velocity preventing flow reversal and resultant water hammer.

2.16.3 Design valves in accordance with the following:

.1 Ductile Iron - ASTM 536 65-45-12.

.2 Disc and seat: 304 Stainless Steel - SS ASTM A276 T304.

.3 Spring: 316 Stainless Steel; stone tumbled and stress relieved - SS ASTM A276 T16.

.4 EPDM seat and helical, stone-tumbled stainless steel center-guided spring

.5 Valve disc shall be centre guided at both ends with an integral shaft and shall be spring loaded for silent operation

.6 The seat and disc shall be replaceable in the field

.7 Valve to close drip-tight preventing flow reversals

.8 Fusion bonded epoxy coating or two-part epoxy coating lined interior and exterior meeting NSF61.

.9 Acceptable manufacturer:

.1 Pratt

.2 Cla-Val

2.17 Ball Valve (on RAW water Sampling line)

2.17.1 Supply and install ball valves as shown on the Contract Drawings and/or as specified herein. Ball valves are used for drain valves, sampling valves, isolation valves of air release and tap water valves.

2.17.2 Valves

.1 Stainless steel 3-piece, full port threaded ball valves, pressure rating 150 psi.

.2 Shop Testing: Certified copies of reports describing the procedures and results of the performance test, leakage test and hydrostatic test for each unit must be submitted to the Consultant.

.3 Valve must be suitable for potable water application.

.4 Materials:

.1 Valve body: stainless steel to ASTM A351-CF8M

.2 Seats and seals: RPTFE

.3 Ball: Type 316 stainless steel

.4 Acceptable Manufacturer:

.5 Apollo 85R-100 Series

.6 Trueline

.7 Pinnacle

2.18 Pressure Relief Valve

2.18.1 The pressure relief valve will be located in the surge line of the BPCS as indicated on the drawings.

2.18.2 Design valves in accordance with the following:

.1 Full internal port, ductile iron body, 150lb flanged ends and stainless-steel internal trim comprising the following:

.1 Machined stainless steel cover bushing

.2 Machined stainless steel stem

.3 Machined stainless steel disc guide.

2.18.3 Machined one-piece stainless steel seat including stem bushing.

2.18.4 Main valves not to include any locating pins, snap rings or stem o-rings

2.18.5 No pistons or rolling diaphragms permitted - all main valves to use a flat diaphragm system

2.18.6 Valve body and cover to include 360º mating machined surfaces to ensure valve stem and cover bushings align concentrically

2.18.7 NSF 61 certified fusion bond epoxy coating or two-part epoxy coating on interior and exterior surfaces.

2.18.8 Pilot system to include stainless steel isolation ball valves, a "Y" strainer and adjustable closing speed control. All pilot lines to be stainless steel or braided hose type.

2.18.9 Equipped with SPDT limit switch assembly

2.18.10 Includes adjustable spring-loaded pressure relief pilot range 138-1380 kPa (20 - 200 psi)

2.18.11 Valve to provide pressure relief functionality

2.18.12 Acceptable Product: Cla-Val model 50-01BKX.

2.19 Air RELEASE ValveS

2.19.1 Provide air release valve. Location and size are as shown on the Contract Drawing.

.1 The air release valve shall automatically exhaust large quantities of air from the header during filling.

.2 The valve shall have threaded inlet and NPT threaded outlet.

.3 Valves shall be certified to NSF 61 for drinking water.

.4 Valves shall be manufactured and tested in accordance with AWWA C512.

.5 Design and Construction:

.6 Pressure Ratings: 1050 kPa (150 psi);

.7 Float and Internal Parts: Type 316 Stainless Steel;

.8 Body and Cover: Cast Iron;

.9 Seal: Buna-N Rubber;

.10 Temperature Range: water to 80 degree Celsius.

.11 Acceptable Manufacturers:

.1 Val-Matic

.2 CLA-VAL

.3 APCO

3 EXECUTION

3.1 Preparation

3.1.1 Prior to installation, inspect and field measure to ensure that previous work is not prejudicial to the proper installation of piping.

3.1.2 Make all minor modifications to suit installed equipment and structural element locations and elevations.

3.1.3 Piping arrangements indicated on the drawings have been established on the basis of the "Design Standard" listed in the specific process equipment sections. If the equipment to be provided is not the Design Standard, at no additional expense to the Town, modify the piping arrangement as necessary.

3.1.4 Advise the Engineer of all modifications. Do not commence work on the related piping until all modifications have been reviewed by the Engineer.

3.1.5 Include any piping modifications in the shop drawings submitted prior to fabrication or installation.

3.2 Handling

3.2.1 Inspect each pipe and fitting prior to installation. Do not install damaged pipe or pipe with damaged protective coatings.

3.2.2 Remove all foreign matter from inside of pipe prior to installation.

3.2.3 Repair pipe with damaged protective coatings with material similar to the original in accordance with the manufacturer's directions and to the satisfaction of the Engineer.

3.2.4 Use proper implements, tools, and facilities for the proper protection of the pipe. Exercise care in the installation so as to avoid damage to pipe or coatings.

3.3 Installation

3.3.1 Fabricate and install pressure piping in accordance with the ASME B31.1 pressure vessel code and the Ontario Power Engineers and Boiler and Pressure Vessel Safety Act and Regulations.

3.3.2 Make adequate provisions in piping and pipe support systems for proper slope and anchorage.

3.3.3 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag or stress.

3.3.4 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.

3.3.5 Accurately cut all piping for fabrication to field measurements.

3.3.6 Install pipes in straight alignment. Do not exceed 10 mm in 10 m variance from the true alignment, in any direction. Fabricate and assemble pipe runs so that the pipework is not

stressed to achieve the desired alignment and that no stresses are transferred to equipment or equipment flanges. The "springing" of pipework to ensure alignment is not permitted. Undo and subsequently remake all pipework connections to ensure that springing does not occur. Take care not to damage equipment, valves or flanges.

3.3.7 Slope instrument air piping to condensate traps. Provide condensate traps as recommended by the manufacturer of the instrument air compressor.

3.3.8 Do not cut or weaken the building structure to facilitate installation.

3.3.9 In parallel pipe runs, offset flanges and/or grooved joint fittings by a minimum of 200 mm.

3.4 Sizing

3.4.1 Supply and install pipes, valves and other fittings according to the sizes and pressure ratings as indicated in this specification and on drawings. Where sizes are not clearly indicated, obtain sizes from the Consultant before proceeding with the work.

3.5 Stainless Steel Welding

3.5.1 Conform to reviewed stainless steel pipe welding procedures, which have been stamped and signed by a Professional Engineer registered in the Province of Ontario, hired by the Contractor.

3.5.2 For all stainless steel pipe intended to convey liquids, use inert gas backing for field and shop welds. For these services, solar flux will not be allowed.

3.6 Passivation

3.6.1 Passivate all stainless steel welds after completion.

3.6.2 Use acid pickling. A pickling paste may be used with the Engineer's approval.

3.6.3 As appropriate, neutralize and/or rinse the joint after passivation.

3.7 Pressure Testing

3.7.1 Give 24 hour written notice of date of tests.

3.7.2 Do not insulate or conceal work until piping systems are tested and accepted.

3.7.3 Conduct all tests in the presence of the Consultant.

3.7.4 Bear all costs of testing including retesting and making good.

3.7.5 Maintain test pressures for at least 4 hours unless otherwise specified.

3.7.6 Piping to be tested to specified test pressure. Leakage from pipes will be zero. No loss of pressure will be accepted.

3.7.7 If leaks are detected in the pipe or any of the appurtenances connected thereto, make any necessary repairs and retest.

3.7.8 Prior to tests, isolate all equipment or other parts that are not designed to withstand test pressures.

3.8 Flushing and Disinfection

3.8.1 Flush process pipe work with clean water when installation work is completed. Repeat this procedure as necessary to ensure removal of all unwanted matter from the system.

3.8.2 Brush clean steel pipe exterior to SSPC-P3 standard prior to painting. Also refer to Section 09900 Painting.

3.8.3 Disinfect lines intended for potable water service after testing in accordance with AWWA C651 and C653.

3.9 Storage

3.9.1 Prior to the installation the piping, valves, fittings and accessories shall be protected and stored indoors in a dry area, in accordance with the Manufacturer's recommendations.

END OF SECTION

Item	Equipment Tag	Description	Valve Type (1)	Size (mm)	Service (2)	Specification Sections	Actuator Type (3)	SCADA Monitored?
1	AR0111	Low Lift Pump 1 Air Relief Valve	ARV	150	RV	2.19	-	No
2	AR0121	Low Lift Pump 2 Air Relief Valve	ARV	150	RV	2.19	-	No
3	CV0111	Low Lift Pump 1 Check Valve	CV	150	CV	2.15	-	No
4	CV0121	Low Lift Pump 2 Check Valve	CV	150	CV	2.15	-	No
5	V0112	Low Lift Pump 1 Discharge Valve	BFV	150	MOV	2.14	SE	Yes
6	V0122	Low Lift Pump 2 Discharge Valve	BFV	150	MOV	2.14	SE	Yes
7	CV0112	Surge Relief Line Check Valve	CV	100	CV	2.15	-	No
8	SV0111	Surge Relief Valve	PRV	100	RV	2.18	-	No
9	V0115	Discharge Header 1/2 Isolation Valve	BFV	250	ISV	2.14	HW	No
10	V0113	Discharge Header 1 Valve 1	BFV	250	ISV	2.14	HW	No
11	V0114	Discharge Header 1 Valve 2	BFV	250	ISV	2.14	HW	No
12	V0123	Discharge Header 2 Valve 1	BFV	250	ISV	2.14	HW	No
13	V0124	Discharge Header 2 Valve 2	BFV	250	ISV	2.14	HW	No
14	BLV0101	Raw Water Sampling Line Valve	BLV	25	ISV	2.17	HW	No

Notes:

1) Valve type:

ARV	Air Release Valve
CV	Check Valve
BFV	Butterfly Valve
PRV	Pressure Relief Valve
BLV	Ball Valve

2) Service:

ISV	Isolation Valve
CV	Check Valve
MOV	Motorized Valve
RV	Relief Valve

3) Actuator: **Related Section 11290 for Electric**

HW	Hand Wheel Actuator
SE	Standard Electric Actuator
ME	Modulating Electric Actuator

1 GENERAL

1.1 Scope

1.1.1 This section covers field hydrostatic pressure and leakage testing of all process piping. The term "piping" shall be used in this section to refer to piping systems, pipelines, or sections thereof.

1.1.2 Testing of other piping is covered in the miscellaneous piping section.

1.2 General

1.2.1 Contractor shall contact applicable regulatory agencies to determine if any special procedures or permits are required for disposal of water used for pressure and leakage testing and to identify acceptable locations for disposal of the water. All requirements and costs associated with notifications and obtaining any discharge permit or approvals shall be responsibility of Contractor.

1.2.2 Engineer or Engineer's representative shall be present during testing and shall be notified of the time and place of testing at least three (3) days prior to commencement of the work. All work shall be performed to the satisfaction of Engineer.

1.2.3 Testing Schedule and Procedure. A testing schedule and test procedure shall be submitted to Engineer for review and acceptance not less than 21 days prior to commencement of testing. The schedule shall indicate the proposed time and sequence of testing of the piping. The testing procedure shall establish the limits of the piping to be tested, the positions of all valves during testing, the locations of temporary bulkheads, and all procedures to be followed in performing the testing.

1.2.4 Special Testing Requirements. Special testing requirements shall be as follows:

.1 Unless otherwise acceptable, during testing of the pipeline, all valves shall be in the open position.

.2 Unless otherwise acceptable, temporary bulkheads shall be provided during testing so that the test pressures are not applied to existing or new valves and hydrants, or to existing water lines, or to any portion of water lines installed under this Contract that have already been put into service.

1.2.5 Water for testing shall be furnished as stipulated in the temporary utilities section. Following completion of testing, the water shall be disposed of in a manner acceptable to Engineer. Unless otherwise permitted, the water shall be kept out of the remainder of the piping.

2 PRODUCTS

2.1 Test Equipment

2.1.1 All necessary connections between the piping to be tested and the water source, together with pumping equipment, flow meter, pressure gauges, and all other equipment, materials, and facilities required to perform the specified tests, shall be provided. All required flanges, valves, bulkheads, bracing, blocking, and other sectionalizing devices shall also be provided. All temporary sectionalizing devices shall be removed upon completion of

testing. Vents shall be provided in test bulkheads where necessary to expel air from the piping to be tested.

2.1.2 Test pressures shall be applied by means of a force pump sized to produce and maintain the required pressure without interruption during the test.

2.1.3 Flow meters and pressure gauges shall be accurately calibrated and shall be subject to review and acceptance by Engineer.

2.1.4 Permanent gauge connections shall be installed at each location where test gauges are connected to the piping during the required tests. Drilling and tapping of pipe walls will be permitted as required. Upon completion of testing, each gauge connection shall be fitted with a removable plug or cap acceptable to Engineer.

3 EXECUTION

3.1 General

3.1.1 At least two (2) weeks prior to commencing any hydrostatic testing, the Contractor shall submit a test plan to the Engineer for review and acceptance.

3.2 Filling and Venting

3.2.1 Before filling the piping with water, care shall be taken to ensure that all air release valves and other venting devices are properly installed and in the open position. Hand operated vent valves shall not be closed until an uninterrupted stream of water is flowing from each valve. The rate of filling the piping with water must not exceed the venting capacity of the installed air vent valves and devices.

3.3 Station Piping Leakage

3.3.1 All piping at the LLPS shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor.

3.4 Blocking and backfilling

3.4.1 Piping shall be adequately blocked, anchored, and supported before the test pressure is applied. Underground piping shall be tested before the joints are covered.

3.5 Pressure Testing

3.5.1 After the piping to be tested has been filled with water, the test pressure shall be applied and maintained without interruption within plus or minus five (5) percent of test pressure for two (4) hours plus any additional time required for Engineer to examine all piping being tested and for Contractor to locate any defective joints and pipe materials

3.5.2 The test pressure shall be in accordance with the requirements specified for pipeline or plant piping.

.1 Pipeline Test Pressure. Unless otherwise noted, piping shall be subjected to a hydrostatic test pressure as indicated in the specific piping sections, or as indicated below.

.1 The test pressure, expressed in metres (ft) of water, to be applied at any point in the piping shall be equivalent to the arithmetic difference between the specified test pressure plane elevation and the elevation of the horizontal centre line of the piping at the selected location.

.2 The value obtained shall be multiplied by 1.423 to obtain psi [9.806 to obtain kPa].

3.5.3 Plant Piping Test Pressure. Unless otherwise noted, piping shall be subjected to the test pressure as indicated in the specific piping sections, as indicated in the piping schedule at the end of this section, or 1.5 times the rated working pressure

3.5.4 All specified tests shall be made by and at the expense of the Contractor in the presence, and to the satisfaction, of the Engineer. Piping shall be tested at the following pressures:

Service	**Pipe Material**	**Test Medium**	**Test Pressure (kPa)**
Process Piping	SS304	Water	1050
Service Water	SS304	Water	1050
Chemical Piping	Teflon/PVC	Water	1050

3.5.5 Leakage may be determined by loss-of-pressure, soap solution, chemical indicator, or positive and accurate method acceptable to the Engineer.

3.5.6 All fixtures, devices, or accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped as required during the testing.

3.5.7 Unless otherwise required by the applicable codes, drainage and venting systems shall be tested with compressed air.

3.5.8 Openings shall be plugged as necessary, and the system shall be charged with air to a minimum pressure of 35 kPa [5 psi]. To be considered free of leaks, the system shall hold the air for 30 minutes without any drop-in pressure.

3.5.9 All necessary testing equipment and materials, including tools, appliances and devices, shall be furnished and all tests shall be made by and at the expense of the Contractor and at the time directed by the Engineer.

3.5.10 All joints in piping shall be tight and free of leaks. All joints which are found to leak, by observation or during any specified test, shall be repaired, and the tests repeated.

.1 After pipeline pressure and leakage testing, water inside the pipeline shall be completely drained.

.2 Gas piping: test as required by authorities having jurisdiction.

3.6 Pipeline leakage testing

3.6.1 Following completion of pressure testing and acceptance by Engineer, the pipeline piping shall be subjected to a leakage test. The duration of the leakage test shall be two (2) hours.

3.6.2 Leakage Test Pressure. The hydrostatic pressure during the leakage test shall be maintained between 100 and 105 percent of the pressure specified for pressure testing of the piping, for the entire duration of the leakage test.

3.6.3 No visible leakage will be accepted.

3.6.4 If Yard Piping is tested concurrently with the Process Piping, the allowable leakage will be in accordance with Div. 2.

END OF SECTION

TABLE 1 - TYPES OF SUPPORTS				
Description and Service			**Type**	
			MSS SP 69 (Note 1)	**Other**
Hangers				
	75 through 250 mm [3 Through 10 inch] pipe			
		For cold insulated piping		
		Clevis	1	B-Line "B3100" or Anvil "260" for steel pipe B-line “B3102” or Anvil “590” for cast iron pipe.
		For uninsulated cold piping		
		Clamp	4	B-Line "3140" or Anvil "212".
		Clevis	1	B-Line "B3100" or Anvil "260" for steel pipe B-line “B3102” or Anvil “590” for cast iron pipe.
	300mm [12 inch] and larger Pipe			
		Clevis or saddle	1	Anvil “260” or “590”
Concrete Inserts, Steel				
	300 mm [12 inch] and smaller pipe		18	Channel 2.66 mm [12 ga [2.66 mm] thick, galv, 41.3 by 34.9 mm [1-5/8 by 1-3/8 inches], min. 200 mm [8 inches] long, anchor lugs on 100 mm [4 inch] centres, at least three lugs, end caps, and filler strip.
	350 mm [14 inch] and larger pipe, fabricated insert, except as noted		--	See drawings.
Beam Clamps, Malleable Iron or Steel, 300 mm [12 inch] and smaller pipe			21	B-Line "3050" and "3055" or Anvil "133" and "134".
			28, 29	Anvil "292".

TABLE 1 - TYPES OF SUPPORTS			
Description and Service		**Type**	
		MSS SP 69 (Note 1)	**Other**
		30	B-Line "3054" or Anvil "228".
Side Beam Bracket		34	B-Line "B3062" or Anvil "202".
Wall Supports and Frames, Steel, 300 mm [12 inch] and smaller pipe (Note 2)			
	Brackets	32	B-Line "B3066" or Anvil "195".
		33	B-Line "B3067" or Anvil "199".
	Prefabricated channels	--	2.66 mm [12 ga] thick, galv, 1-5/8 inches [41.3 by 41.3 mm], with suitable brackets and pipe clamps.
	Offset pipe clamp, 38 mm [1-1/2 inch] and smaller pipe	--	Galv, 32 by 4.7 mm [1-1/4 by 3/16 inch] steel, with 9.5 mm [3/8 inch] bolts.
	Offset pipe clamp, 2 to 50 to 88 mm [3-1/2 inch] pipe	--	Galv, 32 by 6 mm [1-1/4 by 1/4 inch] steel, with 9.5 mm [3/8 inch] bolts.
Floor Supports, Steel or Cast Iron			
	150 mm [6 inch] and smaller pipe	37 (with base)	B-Line "B3090" or Anvil "259".
	200 to 600 mm [8 through 24 inch] pipe	38	B-Line "B3093" or Anvil "264".
Pipe Alignment Guides		--	B-Line "B3281" through "B3287" or Anvil "255".
Turnbuckles Steel		13	B-Line "B3202" or Anvil "230".
Hanger Rods, Carbon Steel, Threaded Both Ends, 10 mm {3/8 inch] minimum size		--	B-Line "B3205" or Anvil "140".
Weldless Eye Nut, steel		17	B-Line "B3200" or Anvil "290".

TABLE 1 - TYPES OF SUPPORTS		
Description and Service	**Type**	
	MSS SP 69 (Note 1)	**Other**
Insulation Protection Saddle	39	B-Line "B3160 Series" or Anvil "160 Series".
Insulation Protection Shield	40	B-Line "B3151" or Anvil "167".

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		**Pipe Support Max Spacing**	**Max Run Without Expansion Joint, Loop, or Bend (Note 1)**	**Expansion Joint Max Spacing (Note 2)**	**Type of Expansion Joints**
		m [ft]	**m [ft]**	**m [ft]**	
Stainless steel					
	31 mm [1-1/4 inch] and smaller	2.1 [7]	9.1 [30]	30.5 [100]	Note 3
	38 to 100 mm [1-1/2 to 4 inch]	3.0 [10]	9.1 [30]	30.5 [100]	Note 3
	100 to 250 mm [4 to 10 inch]	4.5 [15]	24.4 [80]	24.4 [80]	Note 3
	Over 250 mm [10 inch]	5.5 [18]	24.4 [80]	24.4 [80]	Note 3
PVC, Schedule 40 & 80, for services at a maximum temperature of 100°F [38°C], and a maximum specific gravity of 1.0.					
	3 and 6 mm [1/8 and 1/4 inch]	Continuous Support	6.1 [20]	18.3 [60]	Note 3

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		**Pipe Support Max Spacing**	**Max Run Without Expansion Joint, Loop, or Bend (Note 1)**	**Expansion Joint Max Spacing (Note 2)**	**Type of Expansion Joints**
		m [ft]	**m [ft]**	**m [ft]**	
	13 mm [1/2 inch]	1.0 [3-1/2]	6.1 [20]	18.3 [60]	Note 3
	19 and 25 mm [3/4 and 1 inch]	1.2 [4]	6.1 [20]	18.3 [60]	Note 3
	31 and 38 mm [1-1/4 and 1-1/2 inch]	1.3 [4-1/2]	6.1 [20]	18.3 [60]	Note 3
	50 mm [2 inch]	1.5 [5]	6.1 [20]	18.3 [60]	Note 3
	65 mm [2-1/2 inch]	1.6 [5-1/2]	6.1 [20]	18.3 [60]	Note 3
	80 mm [3 inch]	1.8 [6]	6.1 [20]	18.3 [60]	Note 3
	100 mm [4 inch]	1.9 [6-1/2]	6.1 [20]	18.3 [60]	Note 3
	150 mm [6 inch]	2.2 [7-1/2]	6.1 [20]	18.3 [60]	Note 3
	200 mm [8 inch]	2.4 [8]	6.1 [20]	18.3 [60]	Note 3
	250 mm [10 inch]	2.5 [8-1/2]	6.1 [20]	18.3 [60]	Note 3
	300 mm [12 inch]	2.9 [9-1/2]	6.1 [20]	18.3 [60]	Note 3

1 GENERAL

1.1 Scope

1.1.1 This section covers the furnishing and installation of pipe hangers, brackets, and supports. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories.

1.1.2 This section also covers the spacing of expansion joints in piping systems. Expansion joint products and materials are covered in the respective piping sections.

1.1.3 Concrete and fabricated steel supports shall be as indicated on the drawings, as specified in other sections, or, in the absence of such requirements, as permitted by Engineer.

1.2 General

1.2.1 In certain locations, pipe supports, anchors, and expansion joints have been indicated on the drawings, but no attempt has been made to indicate every pipe/valve support, anchor, and expansion joint. It shall be Contractor's responsibility to provide a complete system of the supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements specified herein. Additional pipe supports may be required adjacent to expansion joints, couplings, valves and scum piping.

1.2.2 There may not be instrument supports indicated on the contract drawings, but the Contractor shall provide all required stainless steel supports for the instruments. Submit the shop drawings for the Engineer's review and approval.

1.2.3 The pipe supports shown on the Contract Drawings are typical details. The Contractor may propose alternative pipe supports or hangers, but no extra cost shall be allowed for the changes. The alternative shall be reviewed by the Engineer.

1.2.4 Piping support system components shall comply with specified piping code requirements.

1.2.5 Abbreviations: Reference to standards and organizations in this section shall be as indicated by the following designations:

.1 AISI American Iron and Steel Institute

.2 ANSI American National Standards Institute

.3 ASTM American Society for Testing and Materials

.4 MSS Manufacturers Standardization Society of Valve and Fitting Industry

1.2.6 General Equipment Requirements: The General Equipment Requirements shall apply to all equipment provided under this section.

1.2.7 Pipe hanger or guide shall not be used for a fixed point pipe support.

1.2.8 The Contractor shall provide the detailed piping layout as the shop drawings stamped by a professional engineer who shall coordinate with the expansion manufacturer coupling installation with the coupling manufacturer. Present the fixed and sliding pipe supports locations with couplings on the layout.

1.3 Submittals

1.3.1 Complete data and catalog cuts or drawings covering fabricated pipe supports, fabricated inserts, and stainless steel, galvanized, and copper and plastic coated pipe supports shall be submitted in accordance with the submittals section.

1.3.2 Data shall include a listing of the intended use and general location of each item submitted.

2 PRODUCTS

2.1 Materials

2.1.1 Unless otherwise indicated, all pipe supports shall comply with ANSI/MSS SP 58 and MSS SP 69. Materials of construction for fabricated steel supports are covered in the structural and miscellaneous metals section. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.

2.1.2 Unless otherwise specified or indicated on the drawings, pipe supports shall be fabricated of manufacturer's standard materials and provided with manufacturer's standard finish.

2.1.3 Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

2.1.4 Pipe supports shall be manufactured for the sizes and types of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item. Continuously threaded rod is not acceptable for hanger rods over 12 inches [300 mm] in length.

2.1.5 Unless otherwise acceptable to Engineer, the use of supports which rely on stressed thermoplastic components to support the pipe will not be acceptable.

2.1.6 Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper plated. Portions of pipe supports which come into contact with other metals that are dissimilar shall be rubber or vinyl coated.

2.1.7 Stainless steel supports shall be furnished unless otherwise specified, and shall be AISI Type 304 stainless steel. Stainless steel supports fabricated by welding shall be AISI Type 304L.

2.1.8 A base of stainless steel tee or bend shall be provided where a support is required for the tee or bend. It may be a manufacturer's standard base or a stainless steel pipe to be welded to the support and fittings as per the process details.

3 EXECUTION

3.1 Application

3.1.1 Concrete inserts or anchor bolts shall be used to support piping from new cast in place concrete. Expansion anchors shall be used to fasten supports to existing concrete and masonry.

3.1.2 Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as specified to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as needed to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellows type expansion joints may be located adjacent to the joint.

3.1.3 When expansion joints are required, pipe guides shall be provided adjacent to expansion joints. Guides will not be required where mechanical couplings are permitted as expansion joints. Guides shall be located on both sides of expansion joints, except where anchors are adjacent to the joint. Unless otherwise indicated on the drawings, one guide shall be within four pipe diameters from the joint and a second guide within 14 pipe diameters from the first guide. Pipe supports shall allow adequate movement; pipe guides shall not be used for support. Pipe guides shall be provided at locations as recommended by the manufacturer.

3.2 Types of Supports

3.2.1 The specific products for pipe supports shall be as indicated in Table 1 for the specified type and size of support.

3.2.2 Table 1 Notes:

.1 Typical MSS SP-69 supports and hangers are illustrated on 11190 - F1 . The Contractor may modify the supports and hangers based on the typical ones, but the Engineer's approval shall be required.

.2 Pipe clamps or other devices which rely on the application of a clamping force to the supported pipe in order to maintain the clamp position or location in a prefabricated channel or track will not be acceptable for use with nonmetallic pipe or tubing.

.3 Galvanize the carbon steel plate after welding. The pipe supports for stainless steel pipeline shall be made of stainless steel.

3.3 Support and Expansion Joint Spacings

3.3.1 Pipe supports and expansion joints shall be spaced in accordance with Tables 2. The types of pipes to be supported are as required. Table 2 covers spacings for the standard operating conditions specified for each pipe material.

3.3.2 Table 2 Notes:

.1 Unless otherwise acceptable to Engineer, an expansion joint shall be provided in each straight run of pipe having an overall length between loops or bends exceeding the maximum run specified herein.

.2 Unless otherwise acceptable to Engineer, the spacing between expansion joints in any straight pipe run shall not exceed the maximum spacing specified herein and contract drawings.

.3 Expansion joint fittings are specified in the respective piping procurement sections or acceptable by Engineer's approval. The expansion joint design shall be provided by the Contractor. Submit shop drawings stamped by a Professional Engineer for review.

3.3.3 Provide the pipe expansion joint with two pipe supports on both side of expansion joints above every structural expansion joints. The spacing between two supports shall not be more than 1.0 m.

3.3.4 The Contractor shall provide the detailed piping layout and submit the shop drawings stamped by a professional engineer who shall coordinate the expansion joint installation with the manufacturer.

3.3.5 One of sliding supports between fixed supports shall be a pipe guide as per Process Details in the Contract Drawings.

3.3.6 Provide a one (1) Victaulic Style 77S flexible coupling at every 90 degree bends to allow for deflection.

3.4 Installation

3.4.1 General: All piping shall be supported in a manner which will prevent undue stress on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in equipment access areas:

.1 Where horizontal piping is arranged with two or more parallel lines, trapeze hangers may be used in lieu of individual hangers. Trapeze assembly shall consist of structure attachments as previously specified with rod size dependent upon total weight supported. Spacing of assemblies shall be determined by the minimum pipe size included in the group supported. Trapeze horizontal assemblies shall be structural angle or channel section of sufficient size to prevent measurable sag between rods. All lines shall be attached to the horizontal with intermediate pipe guides and U-bolts or one-hole clamps. Pre-engineered support equipment may be used when selected and installed in accordance with the manufacturer's recommendations.

.2 No copper pipe shall contact a pipe support or hanger of dissimilar metal. Hangers and supports for copper pipe shall be copper-plated, plastic coated, or copper pipe shall be galvanically isolated using Neoprene strips or other material as approved.

.3 No piping shall be supported from the pipe above.

.4 Horizontal piping hanger support rods shall attach to steel beams with center-loading I clamps, or welded beam clips. Hanger support rods shall attach to concrete slabs or beams with inserts.

.5 Anchorage shall be provided to resist both lateral and longitudinal seismic forces. Seismic forces shall be calculated assuming the pipes are full.

3.4.2 Inserts: Reference building structural concrete drawings for concrete inserts. When not provided as part of the building concrete structure, provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams:

.1 Where concrete slabs form finished ceilings, provide inserts flush with the slab surface.

.2 Where inserts are omitted, drill through concrete slab from below and provide thru bolt with recessed square steel plate and nut recessed into and grouted flush with slab. X ray locate existing reinforcing rods before drilling.

.3 Pipe Hangers and Supports. Hanger rod sizing for copper pipe and plastic pipe shall be same as for steel pipe. Install hangers to provide a minimum 1/2 inch [13 mm] space between finished covering and adjacent work.

.4 A hanger shall be placed with 450 mm [18 inches] of each horizontal elbow, and on both sides of all piping accessories and valves weighing 9 kg [20 lbs] or more.

.5 Hangers shall have 38 mm [1 1/2 inches] minimum vertical adjustment.

.6 Support horizontal cast iron and no-hub piping systems adjacent to each joint.

.7 Support vertical piping at every floor using riser clamps.

.8 Support riser piping independently of connected horizontal piping.

.9 Hanger and hanger components shall be sized specifically for the pipe size it is to be used on.

3.5 Placement

3.5.1 Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be as indicated in Tables 2.

3.5.2 Rubber hose and flexible tubing shall be provided with continuous angle or channel support.

3.5.3 Unless otherwise indicated on the drawings or acceptable to Engineer, piping shall be supported approximately 38 mm [1 1/2 inches] out from the face of walls and at least 75 mm [3 inches] below ceilings.

END OF SECTION

1.1.1

TABLE 1 - TYPES OF SUPPORTS				
Description and Service			**Type**	
			MSS SP 69 (Note 1)	**Other**
Hangers				
	75 through 250 mm [3 Through 10 inch] pipe			
		For cold insulated piping		
		Clevis	1	B-Line "B3100" or Anvil "260" for steel pipe B-line “B3102” or Anvil “590” for cast iron pipe.
		For uninsulated cold piping		
		Clamp	4	B-Line "3140" or Anvil "212".
		Clevis	1	B-Line "B3100" or Anvil "260" for steel pipe B-line “B3102” or Anvil “590” for cast iron pipe.
	300mm [12 inch] and larger Pipe			
		Clevis or saddle	1	Anvil “260” or “590”
Concrete Inserts, Steel				
	300 mm [12 inch] and smaller pipe		18	Channel 2.66 mm [12 ga [2.66 mm] thick, galv, 41.3 by 34.9 mm [1-5/8 by 1-3/8 inches], min. 200 mm [8 inches] long, anchor lugs on 100 mm [4 inch] centres, at least three lugs, end caps, and filler strip.
	350 mm [14 inch] and larger pipe, fabricated insert, except as noted		--	See drawings.

TABLE 1 - TYPES OF SUPPORTS			
Description and Service		**Type**	
		MSS SP 69 (Note 1)	**Other**
Beam Clamps, Malleable Iron or Steel, 300 mm [12 inch] and smaller pipe		21	B-Line "3050" and "3055" or Anvil "133" and "134".
		28, 29	Anvil "292".
		30	B-Line "3054" or Anvil "228".
Side Beam Bracket		34	B-Line "B3062" or Anvil "202".
Wall Supports and Frames, Steel, 300 mm [12 inch] and smaller pipe (Note 2)			
	Brackets	32	B-Line "B3066" or Anvil "195".
		33	B-Line "B3067" or Anvil "199".
	Prefabricated channels	--	2.66 mm [12 ga] thick, galv, 1-5/8 inches [41.3 by 41.3 mm], with suitable brackets and pipe clamps.
	Offset pipe clamp, 38 mm [1-1/2 inch] and smaller pipe	--	Galv, 32 by 4.7 mm [1-1/4 by 3/16 inch] steel, with 9.5 mm [3/8 inch] bolts.
	Offset pipe clamp, 2 to 50 to 88 mm [3-1/2 inch] pipe	--	Galv, 32 by 6 mm [1-1/4 by 1/4 inch] steel, with 9.5 mm [3/8 inch] bolts.
Floor Supports, Steel or Cast Iron			
	150 mm [6 inch] and smaller pipe	37 (with base)	B-Line "B3090" or Anvil "259".
	200 to 600 mm [8 through 24 inch] pipe	38	B-Line "B3093" or Anvil "264".
Pipe Alignment Guides		--	B-Line "B3281" through "B3287" or Anvil "255".
Turnbuckles Steel		13	B-Line "B3202" or Anvil "230".

TABLE 1 - TYPES OF SUPPORTS		
Description and Service	**Type**	
	MSS SP 69 (Note 1)	**Other**
Hanger Rods, Carbon Steel, Threaded Both Ends, 10 mm {3/8 inch] minimum size	--	B-Line "B3205" or Anvil "140".
Weldless Eye Nut, steel	17	B-Line "B3200" or Anvil "290".
Insulation Protection Saddle	39	B-Line "B3160 Series" or Anvil "160 Series".
Insulation Protection Shield	40	B-Line "B3151" or Anvil "167".

.1

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		**Pipe Support Max Spacing**	**Max Run Without Expansion Joint, Loop, or Bend (Note 1)**	**Expansion Joint Max Spacing (Note 2)**	**Type of Expansion Joints**
		m [ft]	**m [ft]**	**m [ft]**	
Stainless steel					
	31 mm [1-1/4 inch] and smaller	2.1 [7]	9.1 [30]	30.5 [100]	Note 3
	38 to 100 mm [1-1/2 to 4 inch]	3.0 [10]	9.1 [30]	30.5 [100]	Note 3
	100 to 250 mm [4 to 10 inch]	4.5 [15]	24.4 [80]	24.4 [80]	Note 3
	Over 250 mm [10 inch]	5.5 [18]	24.4 [80]	24.4 [80]	Note 3
PVC, Schedule 40 & 80, for services at a maximum temperature of 100°F [38°C], and a maximum specific gravity of 1.0.					
	3 and 6 mm [1/8 and 1/4 inch]	Continuous Support	6.1 [20]	18.3 [60]	Note 3
	13 mm [1/2 inch]	1.0 [3-1/2]	6.1 [20]	18.3 [60]	Note 3
	19 and 25 mm [3/4 and 1 inch]	1.2 [4]	6.1 [20]	18.3 [60]	Note 3
	31 and 38 mm [1-1/4 and 1-1/2 inch]	1.3 [4-1/2]	6.1 [20]	18.3 [60]	Note 3
	50 mm [2 inch]	1.5 [5]	6.1 [20]	18.3 [60]	Note 3

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		**Pipe Support Max Spacing**	**Max Run Without Expansion Joint, Loop, or Bend (Note 1)**	**Expansion Joint Max Spacing (Note 2)**	**Type of Expansion Joints**
		m [ft]	**m [ft]**	**m [ft]**	
	65 mm [2-1/2 inch]	1.6 [5-1/2]	6.1 [20]	18.3 [60]	Note 3
	80 mm [3 inch]	1.8 [6]	6.1 [20]	18.3 [60]	Note 3
	100 mm [4 inch]	1.9 [6-1/2]	6.1 [20]	18.3 [60]	Note 3
	150 mm [6 inch]	2.2 [7-1/2]	6.1 [20]	18.3 [60]	Note 3
	200 mm [8 inch]	2.4 [8]	6.1 [20]	18.3 [60]	Note 3
	250 mm [10 inch]	2.5 [8-1/2]	6.1 [20]	18.3 [60]	Note 3
	300 mm [12 inch]	2.9 [9-1/2]	6.1 [20]	18.3 [60]	Note 3

2 GENERAL

2.1 Scope

2.1.1 This section covers the furnishing and installation of pipe hangers, brackets, and supports. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories.

2.1.2 This section also covers the spacing of expansion joints in piping systems. Expansion joint products and materials are covered in the respective piping sections.

2.1.3 Concrete and fabricated steel supports shall be as indicated on the drawings, as specified in other sections, or, in the absence of such requirements, as permitted by Engineer.

2.2 General

2.2.1 In certain locations, pipe supports, anchors, and expansion joints have been indicated on the drawings, but no attempt has been made to indicate every pipe/valve support, anchor, and expansion joint. It shall be Contractor's responsibility to provide a complete system of the supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements specified herein. Additional pipe supports may be required adjacent to expansion joints, couplings, valves and scum piping.

2.2.2 There may not be instrument supports indicated on the contract drawings, but the Contractor shall provide all required stainless steel supports for the instruments. Submit the shop drawings for the Engineer's review and approval.

2.2.3 The pipe supports shown on the Contract Drawings are typical details. The Contractor may propose alternative pipe supports or hangers, but no extra cost shall be allowed for the changes. The alternative shall be reviewed by the Engineer.

2.2.4 Piping support system components shall comply with specified piping code requirements.

2.2.5 Abbreviations: Reference to standards and organizations in this section shall be as indicated by the following designations:

.1 AISI American Iron and Steel Institute

.2 ANSI American National Standards Institute

.3 ASTM American Society for Testing and Materials

.4 MSS Manufacturers Standardization Society of Valve and Fitting Industry

2.2.6 General Equipment Requirements: The General Equipment Requirements shall apply to all equipment provided under this section.

2.2.7 Pipe hanger or guide shall not be used for a fixed point pipe support.

2.2.8 The Contractor shall provide the detailed piping layout as the shop drawings stamped by a professional engineer who shall coordinate with the expansion

manufacturer coupling installation with the coupling manufacturer. Present the fixed and sliding pipe supports locations with couplings on the layout.

2.3 Submittals

2.3.1 Complete data and catalog cuts or drawings covering fabricated pipe supports, fabricated inserts, and stainless steel, galvanized, and copper and plastic coated pipe supports shall be submitted in accordance with the submittals section.

2.3.2 Data shall include a listing of the intended use and general location of each item submitted.

3 PRODUCTS

3.1 Materials

3.1.1 Unless otherwise indicated, all pipe supports shall comply with ANSI/MSS SP 58 and MSS SP 69. Materials of construction for fabricated steel supports are covered in the structural and miscellaneous metals section. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.

3.1.2 Unless otherwise specified or indicated on the drawings, pipe supports shall be fabricated of manufacturer's standard materials and provided with manufacturer's standard finish.

3.1.3 Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

3.1.4 Pipe supports shall be manufactured for the sizes and types of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item. Continuously threaded rod is not acceptable for hanger rods over 12 inches [300 mm] in length.

3.1.5 Unless otherwise acceptable to Engineer, the use of supports which rely on stressed thermoplastic components to support the pipe will not be acceptable.

3.1.6 Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper plated. Portions of pipe supports which come into contact with other metals that are dissimilar shall be rubber or vinyl coated.

3.1.7 Stainless steel supports shall be furnished unless otherwise specified, and shall be AISI Type 304 stainless steel. Stainless steel supports fabricated by welding shall be AISI Type 304L.

3.1.8 A base of stainless steel tee or bend shall be provided where a support is required for the tee or bend. It may be a manufacturer's standard base or a stainless steel pipe to be welded to the support and fittings as per the process details.

4 EXECUTION

4.1 Application

4.1.1 Concrete inserts or anchor bolts shall be used to support piping from new cast in place concrete. Expansion anchors shall be used to fasten supports to existing concrete and masonry.

4.1.2 Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as specified to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as needed to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellows type expansion joints may be located adjacent to the joint.

4.1.3 When expansion joints are required, pipe guides shall be provided adjacent to expansion joints. Guides will not be required where mechanical couplings

4.1.4 are permitted as expansion joints. Guides shall be located on both sides of expansion joints, except where anchors are adjacent to the joint. Unless otherwise indicated on the drawings, one guide shall be within four pipe diameters from the joint and a second guide within 14 pipe diameters from the first guide. Pipe supports shall allow adequate movement; pipe guides shall not be used for support. Pipe guides shall be provided at locations as recommended by the manufacturer.

4.2 Types of Supports

4.2.1 The specific products for pipe supports shall be as indicated in Table 1 for the specified type and size of support.

4.2.2 Table 1 Notes:

.1 Typical MSS SP-69 supports and hangers are illustrated on 11190 - F1 . The Contractor may modify the supports and hangers based on the typical ones, but the Engineer's approval shall be required.

.2 Pipe clamps or other devices which rely on the application of a clamping force to the supported pipe in order to maintain the clamp position or location in a prefabricated channel or track will not be acceptable for use with nonmetallic pipe or tubing.

.3 Galvanize the carbon steel plate after welding. The pipe supports for stainless steel pipeline shall be made of stainless steel.

4.3 Support and Expansion Joint Spacings

4.3.1 Pipe supports and expansion joints shall be spaced in accordance with Tables 2. The types of pipes to be supported are as required. Table 2 covers spacings for the standard operating conditions specified for each pipe material.

4.3.2 Table 2 Notes:

.1 Unless otherwise acceptable to Engineer, an expansion joint shall be provided in each straight run of pipe having an overall length between loops or bends exceeding the maximum run specified herein.

.2 Unless otherwise acceptable to Engineer, the spacing between expansion joints in any straight pipe run shall not exceed the maximum spacing specified herein and contract drawings.

.3 Expansion joint fittings are specified in the respective piping procurement sections or acceptable by Engineer's approval. The expansion joint design shall be provided by the Contractor. Submit shop drawings stamped by a Professional Engineer for review.

4.3.3 Provide the pipe expansion joint with two pipe supports on both side of expansion joints above every structural expansion joints. The spacing between two supports shall not be more than 1.0 m.

4.3.4 The Contractor shall provide the detailed piping layout and submit the shop drawings stamped by a professional engineer who shall coordinate the expansion joint installation with the manufacturer.

4.3.5 One of sliding supports between fixed supports shall be a pipe guide as per Process Details in the Contract Drawings.

4.3.6 Provide a one (1) Victaulic Style 77S flexible coupling at every 90 degree bends to allow for deflection.

4.4 Installation

4.4.1 General: All piping shall be supported in a manner which will prevent undue stress on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in equipment access areas:

.1 Where horizontal piping is arranged with two or more parallel lines, trapeze hangers may be used in lieu of individual hangers. Trapeze assembly shall consist of structure attachments as previously specified with rod size dependent upon total weight supported. Spacing of assemblies shall be determined by the minimum pipe size included in the group supported. Trapeze horizontal assemblies shall be structural angle or channel section of sufficient size to prevent measurable sag between rods. All lines shall be attached to the horizontal with intermediate pipe guides and U-bolts or one-hole clamps. Pre-engineered support equipment may be used when selected and installed in accordance with the manufacturer's recommendations.

.2 No copper pipe shall contact a pipe support or hanger of dissimilar metal. Hangers and supports for copper pipe shall be copper-plated, plastic coated, or copper pipe shall be galvanically isolated using Neoprene strips or other material as approved.

.3 No piping shall be supported from the pipe above.

.4 Horizontal piping hanger support rods shall attach to steel beams with center-loading I clamps, or welded beam clips. Hanger support rods shall attach to concrete slabs or beams with inserts.

.5 Anchorage shall be provided to resist both lateral and longitudinal seismic forces. Seismic forces shall be calculated assuming the pipes are full.

4.4.2 Inserts: Reference building structural concrete drawings for concrete inserts. When not provided as part of the building concrete structure, provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams:

.1 Where concrete slabs form finished ceilings, provide inserts flush with the slab surface.

.2 Where inserts are omitted, drill through concrete slab from below and provide thru bolt with recessed square steel plate and nut recessed into and grouted flush with slab. X ray locate existing reinforcing rods before drilling.

.3 Pipe Hangers and Supports. Hanger rod sizing for copper pipe and plastic pipe shall be same as for steel pipe. Install hangers to provide a minimum 1/2 inch [13 mm] space between finished covering and adjacent work.

.4 A hanger shall be placed with 450 mm [18 inches] of each horizontal elbow, and on both sides of all piping accessories and valves weighing 9 kg [20 lbs] or more.

.5 Hangers shall have 38 mm [1 1/2 inches] minimum vertical adjustment.

.6 Support horizontal cast iron and no-hub piping systems adjacent to each joint.

.7 Support vertical piping at every floor using riser clamps.

.8 Support riser piping independently of connected horizontal piping.

.9 Hanger and hanger components shall be sized specifically for the pipe size it is to be used on.

4.5 Placement

4.5.1 Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be as indicated in Tables 2.

4.5.2 Rubber hose and flexible tubing shall be provided with continuous angle or channel support.

4.5.3 Unless otherwise indicated on the drawings or acceptable to Engineer, piping shall be supported approximately 38 mm [1 1/2 inches] out from the face of walls and at least 75 mm [3 inches] below ceilings.

END OF SECTION

1 GENERAL

1.1 Intent of Section

1.1.1 This section covers the supply, delivery, supervision of installation and commissioning of two (2) vertical turbine pumps including motor, appurtenances and tools as specified herein.

1.1.2 The Contractor is responsible for overall coordination of the equipment package to ensure compatibility of the pump unit with their respective motor and accessories, and with the proposed works.

1.2 Related Sections

1.1.3 DIVISION 1 – GENERAL REQUIREMENTS

1.1.4 DIVISION 3 – CONCRETE

1.1.5 Section 11000 – Equipment General Requirements

1.1.6 Section 11090 – Identification and Labelling of Equipment

1.1.7 DIVISION 13 – INSTRUMENTATION, CONTROL AND SCADA

1.1.8 DIVISION 15 – MECHANICAL

1.1.9 DIVISION 16 – ELECTRICAL

1.3 Operating Conditions

1.1.1 The following site operating and water quality conditions are to be used for all design calculations:

.1 40/C maximum/5/C minimum ambient air temperature

.2 25/C maximum/0/C minimum water temperature

.3 95% maximum relative humidity (non-condensing)

.4 7.5 – 8.5 water pH

.5 Elevation 180.0 metres above sea level

.6 Fully enclosed facility

1.4 SHOP DRAWINGS

.1 Submit the Shop Drawings for review in accordance with Section 01330 – Submittal Procedures.

.2 The shop drawing submission shall include, but not be limited to, the following:

.1 Mechanical details and operating characteristics for the proposed pump and motor.

.2 Dimensional drawings showing proposed pump layout and sections together with motor and anchor bolt base plans.

.3 Pump curve illustrated in metric units including $NPSH_R$, efficiency, RPM and brake horsepower data.

.4 Refer to Section 16223 for motor shop drawing submissions.

.5 For each major component include the name of the Manufacturer, type and model of equipment.

.6 Description of the materials of construction of major components. Provide sufficient detail to show the general construction pertinent to the proper review of the equipment.

.7 A precise list of all electrical requirements for the equipment including all controls, monitoring equipment and instruments shall be given including all power characteristics and materials of construction. A wiring schematic and single line diagram of the control panel(s) must be included.

.8 The Supplier shall indicate a list of spare parts which he/she would recommend be purchased and individual prices for each item.

.9 All ancillary equipment to be provided by the Contractor shall be listed.

.10 Special accessories or tools for the adjustment or removal of parts required for any piece of equipment shall be listed and furnished as part of the supply.

1.5 MAINTENANCE DATA

.1 Refer to Section 01770 – Closeout Procedures

2 PRODUCTS

2.1 DETAIL PUMP SPECIFICATION

.1 The pumps, as listed below, shall be of the enclosed line shaft type with the following features:

Item	Value
Number Of Pumps	2 (1 Duty And 1 Standby)
Pump Tag	LLP1, LLP2
VFD	Yes
Design Flow	3,400 m^3/day (each pump)
TDH at design flow	35 m
Maximum Motor Size	25 HP
Discharge Connection Size	150 mm
Max. Motor Speed	1800 rpm
Type	Vertical Turbine

Item	**Value**
Min. Pump Efficiency At Rated Head	80%
Shutoff Head	50 m
Sub-Base	Yes
Strainer	Clip-On Bell Type Strainer
Pump Discharge C/L El. (Approx.)	180.6m

.1 The pump shall be provided with a surface discharge head complete with mechanical seal and having the discharge opening fitted with a flange sized to ANSI B16.1 Class 125. The discharge head shall be of ASTM A53, Grade B fabricated steel or cast iron A48 Class 30 arranged to discharge above the floor level and perpendicular to the pump shaft. Overall height of the discharge head shall accommodate a mechanical seal and flanged adjustable spacer coupling. The top diameter of the discharge head shall match the motor base to distribute the load uniformly and result in an assembly of discharge head and driver which shall create a smooth and pleasing appearance. The discharge head shall include a cast iron housing complete with water flush, bronze gland, bronze bushing, mechanical seal with relief port external fitting for grease lubrication. A steel flanged adjustable coupling shall be furnished to connect the pump's top shaft to the motor shaft and to facilitate vertical adjustment of the impeller while assuring proper clearances, as well as providing access to mechanical seal replacement. The coupling shall be properly sized for motor horsepower and speed. A steel or cast iron foundation plate (bedplate) shall also be supplied complete with cadmium plated anchor bolts.

.2 Mechanical Seal

.1 The mechanical seal shall be John Crane type 1 cartridge style with Viton elastomers, tungsten carbide face, 316SS metal parts, 316SS springs and Ni-resist seat.

.3 Pump Bowls

.1 Suction case, intermediate bowls and discharge bowl shall be of cast iron conforming to ASTM A48, free of foundry imperfections and other detrimental defects and shall be accurately machined and fitted to close dimensions. Bowls shall be equipped with replaceable seal rings on the suction side of the impellers. Pump Bowls shall be designed with open and smooth passages to ensure efficient operation and shall be epoxy lined. Shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated flow or 1.5 times shutoff head, whichever is greater.

.4 Impellers

.1 The impellers shall be constructed from ASTM B584 silicon bronze and shall be of the enclosed type dynamically and statically balanced. They shall be securely fastened to the impeller shaft with keys, tapered split collets or lock nuts. They shall be adjustable vertically by means of an adjusting nut located at the top of the motor.

.5 Pump Shaft

.1 The pump shaft is to be turned and ground stainless steel Type 416 or equal. It shall be supported by bearings above and below each impeller. The suction case bearing is to be bronze, grease packed and protected against entrance of sand or other abrasives. Intermediate bowl bearings are to be lubricated by the water being pumped and may be bronze, cutless rubber or a combination of bronze and rubber. The size of the shaft shall be ample to transmit the horsepower required by the pump and shall not be less than determined by A.S.A. specification B17C entitled, “Code for Design of Transmission Shafting”. Minimum shaft diameter shall be 25mm.

.6 Line Shafts

.1 The line shafts shall be ground and polished stainless steel Type 416, of a size that conforms to the requirements of the American National Standard for Vertical Turbine Pumps ANSI/AWWA E101. The butting faces shall be machined square to the axis of the shaft. The line shafts shall be coupled with 304 stainless steel couplings and shall have a left hand thread to tighten during pump operation. The shaft shall be provided with a non-corrosive sleeve of 304 stainless steel at the location of each guide bearing. Minimum shaft diameter shall be 30 mm.

.7 Lineshaft Bearings

.1 The bearings shall be designed for vertical turbine pump service and be lubricated by the liquid being pumped. They shall be of the flip-over design and mounted in bearing retainers which shall be held in position in the column couplings by means of the butted ends of the column pipes. The retainers shall be equipped with the snap-in cutlass type rubber bearings.

.8 Discharge Column Pipe

.1 The pipe size shall be such that the friction loss will not exceed 1.5m per 30m of column based upon the rated capacity of the pump. The pipe shall be made up of interchangeable sections having a nominal length not exceeding 3m; shall be of standard weight conforming to specifications in Section A5 of ANSI Standard for Vertical Turbine Pumps, AWWA E101 and shall be connected by threaded sleeve type couplings. Discharge column pipe shall be painted with a suitable corrosion resistant finish.

.9 Suction Strainer

.1 A bronze or galvanized bolt-on basket type suction strainer having a net inlet area of at least four times the suction case area shall be supplied.

.10 Motor

.1 The motor for driving the pump shall be of vertical hollow shaft type. The motor shall be of the proper size to drive the pump continuously at any point of the pump performance curve including runout without the load exceeding the nameplate rating of the motor. Size the motor such that throughout its entire operating range, it shall not be permitted to enter into the service factor of the motor. Use service factor of 1.15. The motor shall be NEMA Design B with Class "F" insulation, suitable for an ambient of 40^0C, with 1.15 service factor, and have a drip-proof enclosure. A thrust bearing of high

capacity to carry the weight of all rotating parts plus the hydraulic thrust shall be incorporated into the motor as an integral part of it. The bearings shall be provided with a B10 life rating, under operating conditions, of not less than 100,000 hours. The motor shall be equipped with a non-reverse ratchet feature.

.2 All motors shall be inverter duty rated. The motors shall be equipped with lifting "eyes" capable of supporting the entire weight of the pump and motor. Mounting of motor shall be “P” base.

.3 Motors shall be CSA approved.

.4 The motor shafts shall be of Type 416 stainless steel.

.5 Each motor shall be fitted with terminal boxes on the side. All leads of sufficient length and supplied with solderless lugs for external cable connections.

.6 Motors shall be supplied by the pump manufacturer as a complete assembly without exception.

.11 Vibration

.1 The pump assembly shall be properly balanced and mounted so that the vibrations do not exceed 0.13 mm per metre distance above the mounting flange, in the operating speed range.

.12 The whole pump assembly, including column, line shafting and discharge head must be supplied by the manufacturer.

.13 For reference, the pump system design has been developed based on pump model VIT-DIFM 11CLC manufactured by Goulds Water Technology.

.14 The **system curve** illustrating the duty point is provided at the end of this specification. The pumps will be operated with VFDs and the Contractor shall submit a completed **Technical Data Sheet,** provide manufacturer technical data sheets including dimensional drawings and pump curves with VFD curves.

2.2 CONTROL

.15 Pump system shall be equipped with local control panel as shown on the drawings.

.16 The local control panel shall be equipped with NEMA 4X enclosure and mounted at location shown on Contract drawings.

2.3 ACCEPTABLE MANUFACTURERS

.17 Goulds Water Technology

.18 Flowserve

.19 KSB

.20 Approved equivalent

2 EXECUTION

2.4 INSPECTION AND SUPERVISION OF INSTALLATION

.1 Non-witnessed factory test:

.1 Certified non-witnessed shop test shall be carried out.

.2 Tests using calibrated instruments are to include:

.1 Development of the entire head/capacity pump curve.

.2 Development of the entire NPSHR curve.

.3 Development of the pump efficiency curve and overall efficiency curve.

.3 Submit the two (2) certified copies of the test results for review prior to shipment of the equipment. All tests are to be stamped and signed by an authorized representative of the manufacturer.

.4 Correct any failure to meet the requirements of the Specifications before shipping the equipment to site. If, after correction and retesting, the equipment still fails to meet the requirements of the Specifications, the Supplier's equipment will still be rejected. The cost of any retesting is at no extra cost to the Contract.

.5 Carry out the tests using calibrated instruments in accordance with the latest ASME and the Hydraulic Institute of America Codes. The Owner reserves the right to reject the equipment if the guaranteed pump performance does not fall within the following tolerances:

.1 At rated head: +10% rated capacity or,

.2 At rated capacity: +5% of rated head

.3 0% efficiency at the rated point

.6 Negative tolerances for head capacity and efficiency will not be allowed.

.7 Acceptance of the pumping equipment is subject to Engineer's approval. The acceptance by the Owner of the results of these tests is not to be construed as being final acceptance, but shall be sufficient only to permit the shipment of the equipment to the job site. Final acceptance will be given subject to the satisfactory installation and in place operation of this equipment.

.2 The pumps and accessories shall be installed as indicated on the contract drawings, in accordance with the manufacturer's instructions and as approved by the Engineer.

.3 Prior to start up, the manufacturer's, or its representative, shall ensure the equipment is installed correctly and is ready to be put into service.

.4 Provide for additional supervision of installation by the supplier as necessary.

2.5 TESTING

.5 The pumps shall be subject to a non-witnessed factory test.

.6 Testing shall comply with the latest Hydraulic Institute requirements.

.7 The whole pump assembly, including column, line shafting and discharge head must be tested by the manufacturer.

.8 Site testing of the equipment shall be in the presence of the engineer and conducted by the manufacturer or its representative.

.9 The purpose of the site test is to demonstrate that the equipment meets the performance requirements of the specification, the equipment is suitable for the service and operates in such a fashion that long life can be anticipated.

2.6 COMMISSIONING

.10 Test and commission the equipment in accordance with Section 01820 - Test and Commissioning.

.11 Following site testing, the manufacturer or its representative, shall check that all alarms, lubrication and other features that permits the safe operation of the equipment are present and functioning. Material deficiencies are to be corrected, as necessary, by the Contractor or its sub-contractors.

.12 The manufacturer or its representative shall submit to the Engineer a written report stating that the equipment has been checked and is suitable for operation.

.13 Equipment shall only be accepted after receipt of a satisfactory report submitted by the manufacturer or his authorized representative.

.14 Modify or replace equipment or materials failing required tests.

.15 Perform additional testing required due to changes of material, and/or failure of materials or construction to meet specifications at no extra cost to the Owner.

.16 The manufacturer or its representative shall instruct the Owner's personnel in the proper operation and maintenance of the equipment supplied.

.17 Provide one (1) day for start-up for each set of pumps.

.18 Provide training in accordance with Section 01820 – Demonstration and Training.

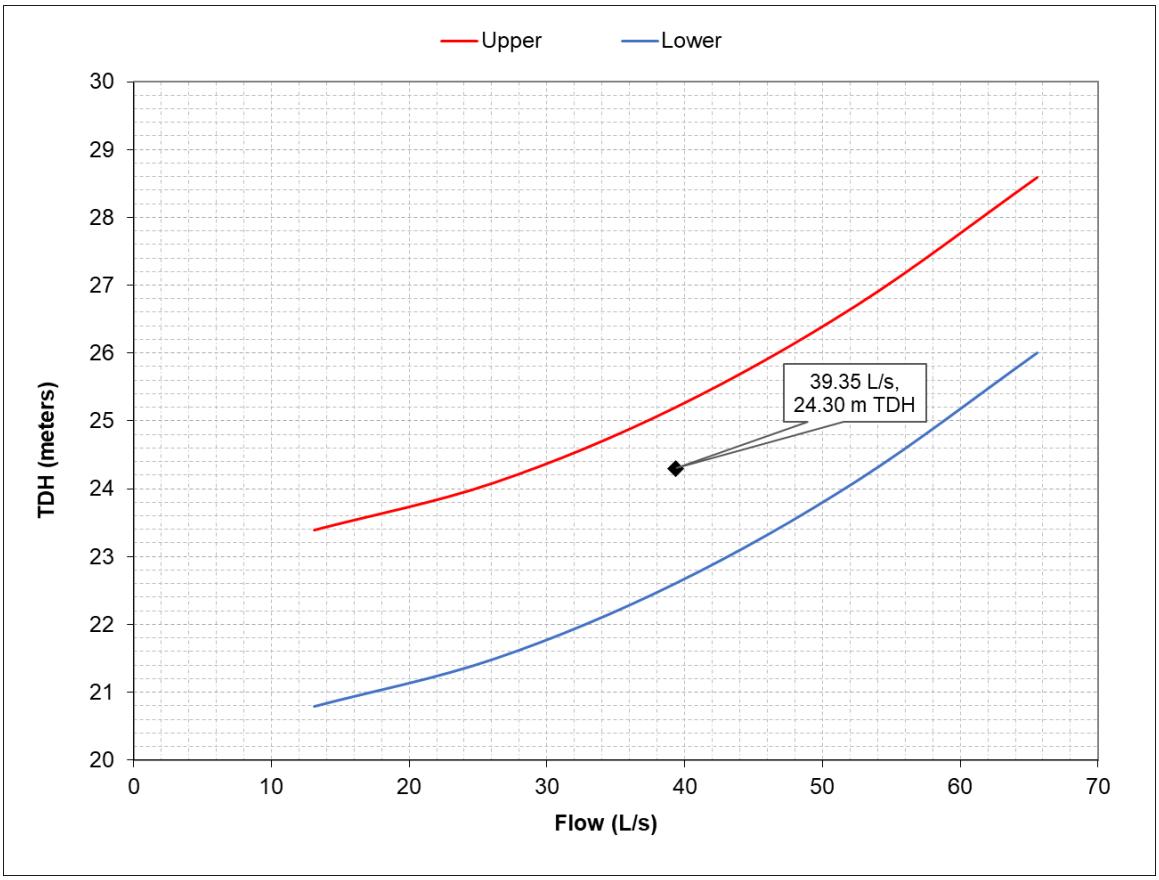
2.7 STORAGE

.19 Prior to the installation, the pumps and accessories should be protected and stored indoors in a dry area, in accordance with the Manufacturer’s recommendations.

2.8 MAINTENANCE

.20 Provide maintenance on Supplier’s material as required by the Supplier from the date of delivery to the initial start-up.

SYSTEM CURVE



TECHNICAL DATA SHEET (Sec11210-S1)

TO BE COMPLETED AND SUBMITTED WITH TENDER

END OF SECTION

VERTICAL TURBINE PUMPS DATA SHEET

Fill out the following tables and submit them with the pump shop drawings.

1.0 GENERAL

1	Pump Name	
2	Pump Location	
3	Tag numbers	
4	Number of Pumps	
5	Pump Unit Application	
6	Pit Dimensions	
7	Chamber Invert Elevation	
8	Chamber Top Elevation	
9	Total Discharge Pipe Length	

2.0 OPERATING ENVIRONMENT AND SITE DETAILS

1	Degree of Pump Unit Immersion	
	Submerged	
2	Service Conditions	
	Liquid Pumped	
	Pumping Temperature	
	Specific Gravity at 10°C	
	Viscosity	
	pH	
3	Ambient Air Temp/RH (-10°C-40°C/<100%*)	

3.0 PERFORMANCE SPECIFICATION

1	Operating Speed (rpm)		
	Maximum Rated Speed		
	Actual		
2	Hydraulic Performance at the Guarantee Point (GP)		
	Flow rate (L/s)		
	Static head (m)		
	Dynamic head (m)		
3	System Data		
	Reference for data/curve		
	Min/max static head (m)		
4	Q (GP)/Q (BEP) – Upper and Lower Limits (%)		
	Limits		
5	Overall Efficiency		
	At the GP		
	At the maximum flow		
6	Motor Power Input (kW)		
	At the GP		
	At the maximum flow		
	Maximum		
7	Performance at Closed Valve		
	Closed valve head (m)		
	Max. operating time (s)		
8	NPSHa		
	At the GP		
	At the maximum flow		
9	NPSHr		
	At the GP		
	At the maximum flow		
	NPSH safety margin at the maximum flow (m)		
10	Solids Handling (mm)		

4.0 DESIGN SPECIFICATION

4.1 General

4.1.1 Weights and Lifting Arrangements

1	Weights	
	Total (kg)	
2	Type of Lifting Point Provided	
	Eye bolts	

	Handle	
	Other (specify)	
3	Lifting Handle Material	
4	Lifting System Required (Y/N)	Y
5	Reference for Purchaser's Particular Specification	
6	Insulation Class	

4.1.2 External Corrosion Protection

1	Coating Specification

4.1.3 O & M Manuals

1	Type Required	
	Supplier's standard	
	Purchaser's standard (specify reference)	

5.0 Guide System

1	Required Length of Guide System (m)	
2	Guide Tube Material	

6.0 Pump Construction

6.1 Pump Casing

1	Material	
2	Outlet (mm)	
	Nominal bore	
	Flange type	
3	Renewable Wear Parts	
	Required/fitted (Y/N)	
	Material(s)	
4	Externally Adjustable Casing/Impeller Clearance Provided (Y/N)	
5	Coatings	
	Required/provided (Y/N)	
	Specification	
	Thickness (microns)	
	Expected efficiency increase (%)	
	Expected life (yrs)	
6	Access For Inspection/ Clearance of Blockages Required (Y/N)	

6.2 Impeller

1	Impeller Type & Material	
	Type	
	Material	
	Number of Blades	
2	Direction of Rotation of Impeller (viewed from the Non-Drive End)	
3	Impeller Dimensions (mm)	
	Actual diameter fitted	
	Maximum diameter	
4	Method of Securing Impeller to Pump Shaft	
	Key	
	Bolt	
	Conical taper	
	Other (specify)	
5	Method of Balancing (Single Vane and Screw Centrifugal Impellers)	
6	Wear Rings	
	Required/provided (Y/N)	

	1. Fixing Method	
	Material(s)	

6.3 Pump Shaft

1	Material

6.4 Pump Shaft Seal

1	Seal Details	
	Type	
	Manufacturer	
	Material	
	Mechanical	

6.5 Bearings and Bearing Lubrication

1	Minimum L_{10h} Life at the GP	
2	Actual L_{10h} Life at the GP	
	Upper bearing	
	Lower bearing	
3	Bearing and Lubricant Details	
	Manufacturer	
	Designation	
	Lubricant	

7.0 Drive and Motor

7.1 Electrical Supply

1	Drive Type	Constant Speed
2	Supply Voltage (, 3 phase, 3 wire, 60 Hz)	
3	Rated Current	
4	Direction of Rotation	

7.2 Duty and Rating

1	MC Rating (kW)	

7.3 Starting

1	Method of Starting	
	Direct-on-line	
	Star-delta	
	Auto-transformer	
	Reduced current	
	Other (specify)	
2	Starting Duty (starts/hr)	
	Maximum required	
	Maximum achievable	
3	Full Load Current (A)	
4	Starting Current (A)	
	Maximum permitted	
	Actual (if > 6.5 x FLC)	

7.3 Enclosure and Cooling

1	Submersion Depth	
2	Method of Cooling	
	Proprietary coolant	
	Air	
	Pumped liquid	

8.0 Cables and Connectors

8.1 Cables and Connectors

1	Cable Length	
2	Fitted to Cable (Y/N)	

8.2 Cable Support System (If Required)

1	Required (Y/N)	

9.0 Sensors

1	Type of Sensor	
	Leakage	
	Connection to LP	

10.0 TESTS

Type of Test	Test Location		Witnessing Requirements		Test Standard	Acceptance Levels & Tolerances
	Factory	Site	(Y/N)	Notice (Days)		
Hydrostatic						
Acceptance (Q, H, Power, Effy)						
NPSH						
Noise						
Thermodynamic						
Control Panel						

1 GENERAL

1.1 Scope

1.1.1 This section covers stainless steel sluice gate and actuator. Sluice gate shall be furnished complete with wall frame, slide, seal, operating stem, stem guide, baseplate, anchor bolts, and appurtenances.

1.2 General

1.2.1 Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the Engineer.

1.2.2 Gate and actuator shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest product of a manufacturer regularly engaged in the production of sluice gates.

1.2.3 The General Equipment Stipulations shall apply to the equipment furnished under this section.

1.2.4 Except as modified or supplemented herein, all sluice gates and actuators shall conform to the applicable requirements of ANSI/AWWA C561.

1.2.5 Design

.1 Liberal factors of safety shall be used throughout the design and especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of each material.

.2 Gates shall be designed to fit into the structures as indicated on the drawings.

1.2.6 Minimum Metal Thickness

.1 Where so indicated in the governing standard, the design safety factors pertaining to tensile, compressive, and shear strength of materials used shall be observed. In addition, unless otherwise acceptable to the Engineer, all portions of submerged components of each gate, exclusive of stem guide wall brackets, shall have a metal thickness of at least 6.4 mm.

1.2.7 Name Plates

.1 Each sluice gate shall be provided with a name plate, with at least 25mm high black baked enamel numerals on anodized aluminum plate. The location of name plate and the method of attachment shall be acceptable to the Engineer. The tag number assigned to each gate shall be as indicated in this specification and as on the Drawings.

1.2.8 Shop Painting

.1 Actuators and other ferrous metal surfaces, except stainless steel, shall be shop painted as per the manufacturer's recommendations. If manufacturer has no recommendations paint as per specification Section 09900.

1.2.9 Shop Testing

.1 All sluice gates shall be completely assembled in the shop to ensure that all parts fit together properly. The factory operation and leak test reports shall be submitted.

1.3 Submittals

1.3.1 Shop Drawing

.1 Submit shop drawing in accordance with Section 01330 - Submittals Procedures.

.2 The slide gates manufacturer shall submit, for acceptance by the Engineer, general arrangement drawings of the equipment supplied under this section.

.3 Shop drawings must indicate all dimensions that will allow the contractor to ensure coordination with dimensions of the installation environment.

.4 Shop drawings will also show sufficient details to determine compliance with the requirements, including the stainless steel plate thickness used for all components.

.5 Shop drawings shall also include certification that the slide gates supplied meet all requirements of AWWA C561.

1.3.2 Design Calculations

.1 The gate manufacturer shall submit, for acceptance by the Engineer, design calculations demonstrating compliance with the design requirements of these specifications and those of AWWA C561. In particular, calculations shall be submitted for the following gate components:

.1 Slide

.2 Seat contact pressure

.3 Frame

.4 Yoke

.5 Stem, stem connection

.6 Lifting nut

.7 Manual actuator operating force

.8 Anchors

1.3.3 Test Reports

.1 The gate manufacturer shall submit upon request, for information, the leakage and operation test reports specific to the actual gates that are being supplied demonstrating their compliance with the maximum leakage rate and maximum operating force allowed.

1.3.4 Installation, Operation and Maintenance Manual

.1 The gate manufacturer shall provide a manual containing the instructions for installation, operation and maintenance of the slide gates.

1.4 Delivery

1.4.1 The manufacturer shall use due and customary care in preparing the gates and accessories for shipment. Self contained frame gates shall be shipped assembled with stem and manual operator. When shipping several gates together, every item shipped separately must be clearly marked to the gate it belongs to.

2 PRODUCTS

2.1 Service Conditions

2.1.1 Sluice gates shall be installed as shown on contract drawings.

2.1.2 The gates shall be upwards opening of the 4 sides sealing type designed for submergence in water.

2.1.3 The material of components of the sluice gate shall be NSF 61 approved for potable water.

2.2 Performance and Design requirements

2.2.1 The design is based on equipment manufactured by Fontaine.

2.2.2 Sluice gate, actuator, and appurtenances shall be designed as following.

Gate Size	1200x2400 mm
Stem Configuration	Non-Rising
Operating Elevation (m)	176.04 m
Gate Bottom Elevation (m)	173.83 m
Seating Head (m)	7 m
Unseating Head (m)	7 m
Actuator Type	Manual Operator with Handwheel

2.2.3 Actuators, regardless of type, shall be sized to produce the torque or thrust required to operate the applicable gate, when the gate is subject to the seating and unseating operating heads. The maximum output torque or thrust provided by the actuator shall not exceed 150 percent of that required to operate the gate under the design conditions.

2.2.4 Both the design head and the operating head shall be measured from the surface of the liquid to the gate invert.

2.3 Acceptable Suppliers

2.3.1 The equipment furnished under this section shall be by Fontaine or Dynamic.

2.4 Materials

Frames, Guides, Slides, Reinforcing Members, and Yoke Beams	Stainless steel, AISI Type 304L
Slide Seal/Guides and Top Seal	Ultra-high Molecular Weight (UHMW) Polyethylene, ASTM D4020
Flush Invert Bottom Seal	Ethylene Propylene (EPDM), ASTM D2000
Compression Cord	Ethylene Propylene (EPDM), ASTM D2000
Wall Gasket	Ethylene Propylene (EPDM), ASTM D2000
Bolts and Hardware	Stainless steel, AISI Type 304
Thrust Nut and Lift Nut	Aluminum Bronze or Manganese Bronze, ASTM B505, C95800 or ASTM B584, C86300
Operating Stems and Couplings	Stainless steel, AISI Type 303 mx and or 316
Actuator Cross Shafts	Stainless steel, AISI Type 304
Stem Support Brackets	Stainless steel, AISI Type 304L
Stem Guide Bushing	Ultra-high Molecular Weight (UHMW) Polyethylene, ASTM D4020
Gear and Bearing Housing	Cast iron, ASTM A48, 35B/40B
Assembly Fasteners	Stainless steel, ASTM F593 and F594, Type 304

Square Nut	Cast aluminum, ASTM B179
Thread Lubricant	John Crane “Thred Gard Nickel” or Crawford “Silver Goop” antiseize compound

2.5 Construction

2.5.1 All stainless steel shall be pickled at the mill in accordance to ASTM A380 before being shipped. After fabrication, surfaces shall be cleaned of all lubricants, grease pencil marks, magic marker, oils, tape, paint, or other organic materials of any type.

2.5.2 All stainless steel surfaces after fabrication shall be given a uniform abrasive grit blast to a profile of 50 to 75 µm [2 to 3 mils], providing a uniform matte finish, using only new blast media which is certified iron-free. Blasting grit shall be black beauty non-metallic 20-40 grit as manufactured by Reed Mineral Company or equal. Blasting shall clean the entire surface and produce an even color, texture, and sheen.

2.5.3 The presence of residual embedded iron shall be determined by using either the 24 hour water test or the ferroxyl test. The method of touch-up, spot pickling, and pickling paste used to remove embedded iron, heat tint, and weld oxides shall comply with ASTM A380, Table A2.1, Part II.

2.5.4 All surfaces shall be adequately protected during fabrication, handling, shipping, and installation to prevent contamination from iron or carbon steel objects, tools, cables, or surfaces.

2.5.5 Slide

.1 Slides shall have a thickness of not less than 6 mm and shall be provided with welded stiffeners to limit deflection to 1/720 of the gate width under the maximum seating or unseating head specified.

.2 Slides shall be adequately reinforced to withstand, without permanent distortion, the maximum thrust which can be transmitted by the operating stem.

.3 Each slide shall have a reinforced pocket or internally threaded nut welded to the slide for connection of the stem. The pocket or nut shall be designed to withstand the maximum thrust which can be transmitted by the operating stem. A minimum safety factor of 5 shall be used with regard to tensile, compressive and shear strength of the plate, members, and welds.

2.5.6 Frame

.1 Each frame shall be an integral unit of extruded or welded structural shapes having a thickness of not less than 6.4 mm.

.2 Frames shall be designed for installation on the face of concrete walls. The frame thickness shall not be less than 9.5 mm (3/8 inch) if seating or unseating head is more than 4.0 m.

.3 Bottom of frame will be of the flush invert type and will be floor mounted.

.4 Top and side flange of frame will be mounted over a concrete wall.

2.5.7 Guides

.1 Guide shall be provided on each side of each frame. Guides shall be sufficiently strong so that no further reinforcing will be required where the guides extend above the operating floor.

.2 Guides shall support the entire height of the slide in all positions.

2.5.8 Seating Faces

.1 Gates shall be provided with full-length plastic seats or bearing bars on both faces of the slide. Seats and bars shall be securely attached to the frame with stainless steel retainers and/or stainless steel bolts.

.2 Seat bearing area shall have a minimum width of 13 mm±. Seating faces shall be secured to either the gate frame or slide, but not both, to ensure that they will remain in place without becoming distorted or loose during the life of the gate. On site replacement of the seating faces must be possible without removing the gate frame from the structure.

2.5.9 Seals

.1 Seals shall be capable of being replaced on site without removing the gate frame from the structure. If a retainer bar is used to fasten the seal to the frame or slide, it shall have adjustable screws keeping the seal in compression. The seal design shall be the standard design of the manufacturer, provided it meets the leakage requirements of the governing standard.

.2 Each seal shall be provided with a full-length retainer bar which shall compress the seal and prevent leakage between the seal and the frame member.

.3 A compressible seal shall be securely attached to the bottom of the slide or to the frame invert. The seal shall be of sufficient length to seal the bottom corners of each slide.

2.5.10 Operating Stems

.1 Operating stem shall conform to the requirements of AWWA C561 except as modified herein. Stems shall be designed so that the slenderness ratio (L/R) shall be no less than 200. Contact surfaces of threads shall be rolled or machined and polished to a 63 micro inch finish, or smoother. Each stem shall be securely attached to the slide.

.2 Stems shall be of sufficient size to withstand, without damage or permanent distortion, the tensile and compressive stresses resulting from the application of 1.25 times the output thrust of the actuator in the stalled motor condition.

2.5.11 Anchor Bolts

.1 The gate manufacturer shall furnish suitable anchor bolts for each item of equipment supplied herein. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed.

.2 Anchor bolts shall be stainless steel, and alloy type shall be as required. The anchor bolts shall be at least 19 mm diameter. Anchor bolts shall be accurately located and a length approximately 8 times the bolt diameter. Two nuts and a washer shall be furnished with each anchor bolt.

2.5.12 Manual Operator

.1 Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 178 N (40 lb) on the handwheel, and shall be able to withstand, without damage, an effort of 356 N (80 lb).

.2 Provide position indicator along with all accessories required.

.3 Provide 51 x 51 mm square nut on floor box to allow gate being driven by a portable electric operator.

.4 Provide operator with ball bearing to take operating thrust and designed to force gates downwards as well as for lifting the gate.

2.6 Factory Tests

2.6.1 The gate shall be tested in the factory for leakage and for operating force. Leakage shall be measured at the unseating design pressure. Operating force shall be measured with the gate in vertical position, with and without the design pressure.

2.6.2 Factory test reports shall be available on request for all gates supplied.

2.7 Shop Painting

2.7.1 All iron and steel surfaces, except machined surfaces and stainless steel surfaces, shall be shop cleaned by blasting in accordance with the coating manufacturer's recommendations and finish painted with an epoxy or epoxy/polyurethane coating system.

2.7.2 Actuators and other non-submerged components shall be painted with one coat of epoxy paint having a dry film thickness of at least 125 µm [5 mils] and one topcoat of polyurethane having a dry film thickness at least 50 µm [2 mils].

2.7.3 All components subject to submergence shall be painted with two coats of epoxy paint having a total combined dry film thickness of at least 250 µm [10 mils].

2.7.4 Finish color shall be medium gray, except for handwheels, levers, and other operating devices, which shall be safety red. Field painting of gates, actuators, and appurtenances, other than touchup painting, will not be required. A sufficient quantity of additional coating materials shall be furnished by the gate manufacturer to permit field touchup of damaged coatings.

3 EXECUTION

3.1 Inspection

3.1.1 All gate and accessories shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and re-cleaned to the original requirements by the Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by the Engineer or Owner before its use.

3.2 Installation

3.2.1 It is the responsibility of the Contractor to handle, store and install the gate in strict accordance with the manufacturer's instructions and recommendations.

3.2.2 The gate assemblies must be installed on a true vertical plane, square and plumb. The operating stem shall be accurately aligned with the gate guides and properly greased.

3.2.3 Each sluice gate shall be carefully installed and adjusted for proper operation. Care shall be taken to avoid warping the gate frames and to maintain tolerances between seating faces.

3.2.4 All bolts shall be tightened and all items requiring lubrication shall be lubricated. Anti seize thread lubricant shall be liberally applied to the threaded portion of stainless steel anchor bolts during installation and tightening of nuts. Excess lubricant shall be thoroughly removed following final tightening.

3.2.5 After installation, each gate shall be operated through at least two complete open close cycles, readjusted and re-operated as necessary, and left in a condition acceptable to the Engineer.

3.3 Installation Check

3.3.1 An experienced, competent, and authorized representative of the gate manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is Field Leakage Tested in accordance with standard industry procedure. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

3.3.2 The gate shall be operated on its complete open-close cycle to confirm operation without binding, scraping or distorting. Operating effort on the crank, handwheel or T-wrench shall be observed or measured.

3.3.3 Each manufacturer's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

3.3.4 All costs for these services shall be included in the Contract Price.

3.4 Field Quality Control

3.4.1 After installation, all gates shall be tested for leakage rate.

3.4.2 Leakage exceeding the specified limits which is discovered within the correction period stipulated in the General Conditions, shall be repaired by and at the expense of the Contractor. This requirement applied whether pressure testing is required or not.

3.4.3 Under the design head, seating or unseating, the leakage shall not exceed 1.24 L/min/meter of seating perimeter, as per AWWA Standard C561.

3.5 Training

3.5.1 In addition to the installation and operation check required by the General Equipment Stipulations and the manufacturer's field services required by the quality control section, the manufacturer shall furnish the services of a competent and experienced operator of the equipment, who is directly employed by the manufacturer, to instruct the Owner's operating personnel in the proper operation and maintenance of the equipment.

3.5.2 Training shall be provided as specified in Section 01820 – Demonstration and Training.

3.6 Warranty

3.6.1 Each unit shall be new and shall carry the full manufacturer's warranty on parts, service and performance. Warranty shall begin at substantial completion. The warranty shall include replacement of all defective equipment and shall extend two (2) years beyond substantial completion.

3.6.2 Any location where corrosion is evident shall be considered a failure of the material or the protection system. Before starting work, the manufacturer shall submit to the Engineer for review, an analysis of the cause of the failure and details of the proposed corrective work. The manufacturer shall make repairs acceptable to the Engineer at all points where failures are observed within the Warranty Period.

3.6.3 Each unit shall be inspected at the end of the warranty period by representatives of the Owner, the Engineer and the manufacturer to identify any failures that may have occurred. The manufacturer shall establish the date of each inspection and shall notify the Owner at least 30 days in advance. The scheduled inspection shall not relieve the manufacturer from the obligation to perform corrective work whenever needed.

3.6.4 The manufacturer shall prepare and deliver to the Owner an inspection report covering each inspection, indicating the number of type of failures observed, material and part where materials have failed, the percentage of the surface area where corrosion protection system failure has occurred, and the names of the persons making the inspection. Colour photographs illustrating each type of failure shall be included in the report.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers furnishing manual and powered valve actuators and accessories.

1.2 General

1.2.1 Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1.2.2 Actuators shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of actuators.

1.2.3 General Equipment Requirements: The General Equipment Requirements shall apply to the equipment furnished under this section.

1.2.4 Governing Standards: Except as modified or supplemented herein, all powered actuators shall conform to applicable requirements of ANSI/AWWA C541 and C542, Class 150B:

.1 Except as modified or supplemented herein, all manual and cylinder actuators for butterfly and eccentric plug valves shall conform to the applicable requirements of ANSI/AWWA C504.

.2 Except as modified or supplemented herein, all manual actuators for ball valves shall conform to the applicable requirements of ANSI/AWWA C507.

1.2.5 Power Supply: Power supply to electric actuators will be as indicated on the valve schedule or as indicated on the drawings.

1.2.6 Marking: Each actuator shall be marked with the manufacturer's name, model number, and the country of origin. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the actuator.

1.2.7 Temporary Number Plates: Each actuator shall be factory tagged or marked to identify the actuator and the applicable valve by number or service as indicated in the valve schedule.

1.3 Submittals

1.3.1 In accordance with Section 01330 - Submittals.

1.3.2 Complete drawings, details, and specifications covering the actuators and their appurtenances shall be submitted in accordance with the submittals section. Submittal drawings shall clearly indicate the country of origin of each actuator and its components.

1.3.3 The drawings shall include separate wiring diagrams for each electrically operated or controlled actuator and the electrical control equipment. Each actuator drawing shall be identified with the respective valve number or name.

1.3.4 For electric or cylinder actuators, certified copies of reports covering proof of design testing of the actuators as set forth in Section 5 of ANSI/AWWA C541 and C542, together with an affidavit of compliance as indicated in Section 6.3 of ANSI/AWWA C541 and C542, shall be submitted to Engineer before the actuators are shipped.

1.4 Delivery, Storage, and Handling

1.4.1 Shipping shall be in accordance with the shipping section. Handling and storage shall be in accordance with the handling and storage section.

2 PRODUCTS

2.1 Performance and Design Requirements

2.1.1 General: Actuators and appurtenances shall be designed for the conditions and requirements as indicated in the respective valve and gate sections.

2.1.2 Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one third of the yield point or one fifth of the ultimate strength of each material.

2.1.3 Valve Actuators: Each actuator shall be designed to open or close the valve under all operating conditions. Actuators shall be designed for the maximum pressure differential across the valve and maximum velocities through the valve where indicated in the valve schedule:

.1 Valve actuators shall be provided and adjusted by the valve manufacturer. Actuator mounting arrangements and positions shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the drawings or directed by Engineer.

.2 When valves are to be buried, submerged, or installed in vaults, the actuators and accessories shall be sealed to prevent the entrance of water. The design water depth shall be as indicated on the drawings but not less than 6.1 m [20 feet].

2.1.4 Limit Switches: Limit switches shall be provided as indicated in the valve schedule:

.1 For manual or cylinder type actuators, each limit switch shall be heavy duty type, with a cast NEMA Type 4 enclosure, a spring return roller lever, and four isolated contacts (two normally open and two normally closed) rated 10 amperes at 120 to 480 volts ac and 5 amperes at 125 volts dc. The switches shall be Allen Bradley "802T" or Square D "9007 Type C".

.2 Limit switches for programmable and standard electric actuators shall be as indicated in their respective paragraphs.

2.2 Materials

2.2.1 Except as modified or supplemented herein, materials used in the manufacture of actuators shall conform to the requirements of ANSI/AWWA C504, C541 and C542.

2.3 Valve Manual Actuators

2.3.1 General: Manual actuators of the types listed in the valve schedule shall be provided by the valve manufacturer:

.1 Unless otherwise indicated or specified, each geared manual actuator shall be equipped with an operating handwheel.

.2 The direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body or actuator shall have cast thereon the word "Open" and an arrow indicating the direction to open.

.3 The housing of traveling nut type actuators shall be fitted with a removable cover which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling nut type operating mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or setscrews to prevent rotation of the nut or collar on the reach rod will not be acceptable.

.4 Each actuator shall be designed so that shaft seal leakage cannot enter the actuator housing.

.5 Actuators shall produce the required torque with a maximum pull of 356 N [80 lbs] on the lever, handwheel, or chain. Actuator components shall withstand, without damage, a pull of 890 N [200 lbs] on the handwheel or chainwheel or an input of 407 J [300 foot lbs] on the operating nut.

2.3.2 Handwheels: Handwheel diameters shall be at least 200 mm [8 inches] but not more than 600 mm [24 inches] for 750 mm [30 inch] and smaller valves and not more than 750 mm [30 inches] for 900 mm [36 inch] and larger valves.

2.3.3 Chain wheels: Unless otherwise specified in the valve schedule, all valves with center lines more than 2.0 m above the floor shall be provided with chainwheels and operating chains. Each chainwheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot dip galvanized or zinc plated carbon steel and shall be looped to extend to within 1.2 m [4 feet] of the floor below the valve.

2.3.4 Levers: Levers shall be capable of being locked in at least five (5) intermediate positions between fully open and fully closed. In any building or structure containing lever operated valves, at least two operating levers shall be provided for each size and type of lever operated valve.

2.3.5 Wrench Nuts: Unless otherwise specified in the valve schedule or on the drawings, wrench nuts shall be provided on all buried valves and on all valves that are to be operated through floor boxes. Unless otherwise directed by Owner, all wrench nuts shall comply with Section 3.15 of AWWA C500. At least two operating keys shall be furnished for operation of the wrench nut operated valves.

2.3.6 Operating Stands: Operating stands shall be provided in the locations indicated on the drawings. Operating stands shall support the handwheel approximately 900 mm [36 inches] above the floor. A sleeve made from standard weight galvanized steel pipe shall be provided for the opening in the floor beneath each operating stand. When stems are 3 m [10 feet] or longer, a suitable thrust bearing shall be provided in each operating stand to carry the weight of the extension stem.

2.4 Standard Electric Actuators

2.4.1 General: Standard electric actuators as listed in the valve schedule shall be provided by the valve manufacturer:

.1 Unless otherwise specified actuators to have an operational temperature range of -30°C to 60°C.

.2 Standard electric actuators for 300 mm [12 inch] and smaller butterfly valves and eccentric plug valves shall be quarter-turn type.

.3 All other standard electric actuators shall be multiturn type.

.4 Each standard electric actuator shall be furnished complete with a motor, gearing, handwheel, limit switches and torque sensors, lubricants, heating elements, wiring, and terminals. Each actuator shall be constructed as a self-contained unit with a cast iron or aluminum alloy housing, of a type as indicated in the valve and gate schedules, and shall be integrally assembled on the applicable valve or gate by the valve or gate manufacturer.

.5 Actuators shall be sized to guarantee valve closure at the specific differential pressure.

.6 Actuators shall be designed to cycle the valve from the fully open to the fully closed position or the reverse in approximately 60 seconds or as indicated in the valve schedule.

.7 Actuator motors may be mounted horizontally adjacent to or vertically above the reduction gearing. All gearing shall be oil or grease lubricated.

.8 Acceptable Suppliers:

.1 Rotork

.2 Auma.

2.4.2 Motors: Motors shall be totally enclosed, high torque design made expressly for valve actuator service, capable of operating the valve under full differential pressure for two complete strokes or one complete cycle of travel without overheating. Motors shall be designed in accordance with NEMA standards and shall operate successfully at any voltage within 10 percent above or below rated voltage. Motor bearings shall be permanently lubricated. Motors shall be CSA approved and of explosion-proof design.

2.4.3 Power Gearing: Power gearing shall consist of hardened steel spur or helical gears and alloy bronze or hardened steel worm gear, all suitably lubricated, designed for 100 percent overload, and effectively sealed against entrance of foreign matter. Steel gears shall be hardened to at least 350 Brinell. Planetary or cycloidal gearing or aluminum, mild steel, or nonmetallic gears will not be acceptable. Gearing shall be designed to be self locking so

that actuation of a torque switch by a torque overload condition will not allow the actuator to restart until the torque overload has been eliminated. If a secondary gear box is required, it shall be designed to withstand the locked rotor torque of the actuator.

2.4.4 Handwheel Mechanism: The handwheel shall not rotate during motor operation. During handwheel operation the motor shall not affect the actuator operation. The actuator shall be responsive to electrical power and control at all times and, when under electrical control, shall instantly disengage the handwheel. The handwheel shall rotate counterclockwise to open the valve. An arrow indicating the opening direction and the word "Open" shall be cast on the handwheel. The force required to operate the handwheel shall not exceed 350 N [80 lbs]. The handwheel shall have a padlockable declutch lever.

2.4.5 Torque Sensing: Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device. Each torque sensing device shall be provided with an adjustment setting indicator. The adjustment shall permit a variation of approximately 40 percent in torque setting. Switches shall have a rating of not less than 6 amperes at 120 volts ac and 0.5 ampere at 115 volts dc.

2.4.6 Limit Switches: Each standard electric actuator shall be designed to be readily field adaptable for four limit switch assemblies. Each switch assembly shall consist of at least three separate limit switches, shall be operated by the driving mechanism, and shall be independently adjustable to trip at any point at and between the fully open and fully closed valve positions. All switches shall have an inductive contact rating of not less than 6 amperes at 120 volts ac, 3 amperes at 240 volts ac, 1.5 amperes at 480 volts ac, and 0.5 ampere at 115 volts dc.

2.4.7 Each quarter turn actuator shall be provided with end of travel limit switches in addition to four (4) SPDT switches, each independently adjustable at any point of valve travel.

2.4.8 Heating Elements: Space heating elements shall be provided to prevent condensation in the motor and limit switch housing. Heating elements shall be rated 120 volts ac. Heaters shall be continuously energized.

2.4.9 Terminal Facilities: Terminal facilities for connection to motor leads, switches, position transmitter, and heating elements shall be provided in readily accessible terminal compartments. Each terminal compartment shall have at least two openings for external electrical conduits, one sized at least 19 mm [3/4 inch] and the other at least 31 mm [1 1/4 inches]. Each terminal compartment shall be large enough to allow easy routing and termination of fifteen 12 AWG [4 mm2] conductors.

2.4.10 Controller: Each valve shall be furnished with a reversing controller located inside the actuator enclosure and shall have controller devices as indicated in the valve schedules. The controller shall be equipped with:

.1 A motor overload protective device in each phase or solid state motor protection.

.2 A space heater element, rated 120 volts ac, sized to be continuously energized for prevention of condensation within the controller enclosure.

.3 A fused control power circuit taken from one power lead on the load side of the breaker and line side of the reversing starter to ground. If power supply is greater than 120 volts ac, a control power transformer with fused secondary, with volt-ampere capacity suitable for starter control plus continuous service to space heater elements in motor housing, limit switch compartment, and controller enclosure.

.4 A terminal block with connectors for all external controls. All leads from the actuator motor and limit switch assembly shall be routed to terminal connections in the controller for external connections to all other control devices.

.5 Auxiliary control contacts as indicated in the electrical schematics.

.6 Reversing controllers shall be both mechanically and electrically interlocked and shall be provided with the necessary direct-operated auxiliary contacts for required interlocking and control.

.7 Valve controllers shall be expressly selected for long life and reliable, low maintenance service under rugged service conditions.

2.4.11 Control Module:

.1 Control Performance: For any operating torque within the specified range of the valve actuator, the valve and actuator shall perform within these specified limits:

.2 Linearity: Linearity of actual valve position as compared to demand signal shall be within ±4 percent of span over the entire operating range.

.3 Repeatability: For any repeated demand signal to the valve actuator, the actual valve position shall be repeated.

.4 Deadband: Deadband of the valve actuator shall be adjustable from 1 to 10 percent of span.

.5 Hysteresis: For any repeated demand signal to the valve actuator, from either an increasing or a decreasing direction, the actual valve position shall be repeated within 1 degree of valve shaft rotation.

2.4.12 Communication and System Integration and Connectivity:

.1 Provide hardwired communication for each actuator for connectivity to the communication system provided at the facility.

.2 Actuator shall be capable of providing/accepting the following minimum digital input/outputs”

.1 Control Mode – Digital Output

.2 Fault Status – Digital Output

.3 Open Status – Digital Output

.4 Closed Status – Digital Output

.5 Open Command – Digital Input

.6 Close Command – Digital Input

.3 Provide all required hardware, software and programming so as to provide full integration and connectivity into the system.

2.4.13 The actuator shall be rated for 600V, 3 phase operation.

2.4.14 Enclosures:

.1 Enclosure ratings:

.1 EEMAC 4X for indoor applications.

.2 Actuator enclosure to be watertight with external fasteners on the actuator made of stainless steel. Fasteners on limit switch and terminal compartments to be captured to prevent loss while covers are removed.

.3 The actuator to have an integral, separately sealed wire termination compartment and utilize 'O' ring seals at removable cover joints. The actuator to maintain its non-hazardous enclosure ratings even with the wiring compartment access cover removed.

2.5 Actuator Sizing

2.5.1 The actuator to be size based on information provided by the valve supplier to guarantee valve closure at the specified flow velocity and differential pressure and include a 50% margin of safety.

2.5.2 Design the actuator to provide rated torque with supply voltage variations of plus or minus 10% of the nominal supply value.

2.6 Actuator Accessories

2.6.1 Extension Stems: Extension stems and stem guides shall be furnished when indicated in the respective valve schedules, indicated on the drawings, or otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the actuator shaft. Extension stems shall be connected to the actuator with a single Lovejoy "Type D" universal joint with grease filled protective boot. All stem connections shall be pinned:

.1 At least two stem guides shall be furnished with each extension stem, except for buried valves. Stem guides shall be of cast iron, bronze bushed, and adjustable in two directions. Stem guide spacing shall not exceed 100 times the stem diameter or 3m [10 feet], whichever is smaller. The top stem guide shall be designed to carry the weight of the extension stem. The extension stem shall be provided with a collar pinned to the stem and bearing against the stem thrust guide.

.2 Extension stems for chemical resistant butterfly valves located in drainage sumps shall be the two-piece type with stainless steel stem, PVC housing, wall support, and collar. Unless otherwise indicated on the drawings, the length of the stem extension shall be as necessary to position the valve operator 300mm [12 inches] above the maximum liquid level in the immediate area.

.3 Extension stems for buried valve actuators shall extend to within 150mm [6 inches] of the ground surface, shall be centred in the valve box using spacers, and shall be equipped with a wrench nut.

.4 Extension stems for buried valve actuators shall be provided with position indicators as specified in the valve schedules.

2.6.2 Position Indicators: Unless otherwise specified, each valve actuator shall be provided with a position indicator to display the position of the plug or disc relative to the body seat opening:

.1 For quarter turn plug, ball, or cone type valves installed in interior locations, the indicating pointer shall be mounted on the outer end of the valve operating shaft extension and shall operate over an indicating scale on the operating mechanism cover. Where the shaft passes through the cover, a suitable stuffing box or other seal shall be provided to prevent the entrance of water.

.2 Each actuator for butterfly valves, except where located in manholes, buried, or submerged, shall have a valve disc position indicator mounted on the end of the valve shaft. A disc position indicator shall also be provided on each operating stand or the actuator mounted thereon.

2.7 Shop Painting

2.7.1 All ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valve actuators and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.

2.7.2 The following surfaces shall be painted:

.1	Polished or Machined Surfaces:	Rust Preventive compound.
.2	Other Surfaces:	Epoxy enamel.
.3	Actuators and Accessories:	Universal primer.

3 EXECUTION

3.1 Installation

3.1.1 Actuators will be installed with valves in accordance with Section 11101.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers the furnishing and installation of an Intake Screen with automated backwash system and appurtenances.

1.1.2 The following items are a part of this section and shall be furnished by one manufacturer to ensure a properly designed and integrated intake system.

.1 One (1) Johnson Intake Screen assembly(s) of all-welded continuous slot Vee-Wire® construction.

.2 Johnson Hydroburst® System for air flushing of screen surface for debris and frazil ice removal. (Section 4)

1.2 Quality Assurance

1.2.1 The entire intake screen system shall be furnished by a single manufacturer who shall comply with the following:

.1 The equipment manufacturer must maintain an ongoing quality assurance program, including ISO-9000 certification.

.2 The single manufacturer supplying this equipment must be able to furnish proof of over (100) installations and (20) years of manufacturing equipment of similar technology.

.3 The equipment manufacturer must manufacture their own screen for the intake assembly. Manufactures that have to source screen from an outside source will not be considered

.4 All stainless or Z-Alloy intake screens shall be certified NSF/ANSI Standard 61 (NSF-61) for drinking water system components.

1.3 Substitutions

1.3.1 Manufacturers other than that which is specified and/or not meeting Every provision of the specification shall be required to submit a **complete and detailed Pre-Qualification Package** with the bid. Any Pre-Qualification Package must contain as a minimum:

.1 Detailed layout drawings

.2 Supporting flow distribution data via a CFD (Computational Fluid Dynamics) analysis.

.3 Welder certifications

.4 Evidence of a recognized ongoing quality assurance program.

.5 Detailed component specifications and catalog cuts as required.

.6 Detailed list of All Variations required from the original design, referencing appropriate sections of the specifications and locations on the drawings.

.7 Full installation reference list of at least fifty customers that includes similar proposed equipment.

.8 NSF 61 certified number

2 PRODUCTS

2.1 General

2.1.1 All system components and equipment utilized in the intake screen system, including the system described in Section 1.1 shall be furnished as a complete integrated system by one manufacturer; Johnson Screen, New Brighton, MN.

2.2 Capacity

2.2.1 The intake assembly capacity shall be 6.8 MLD at a maximum through-slot velocity, as a result of water withdrawal of 0.035 m/s. The corresponding average through-slot velocity shall be 80% - 90% of the maximum velocity. Pressure drop through the entire intake, which includes all the components of the intake assembly - screen, modifiers, outlet pipe, etc. shall be approximately 0.38 m at the designed flow. Refer to Hydraulic Profile drawing D-011. The hydraulic design of this system is based on this maximum headloss – screens that exceed this headloss are not acceptable. The manufacturer's clean screen assembly headloss must be stated in the bid documents.

2.2.2 The total intake assembly capacity of 6.8 MLD) shall be handled by one (1), Johnson Screens Model T24MF intake tee screen assembly(s).

2.2.3 Evidence of the intake assembly capacity and flow distribution shall be proven by a Computational Fluid Dynamic (CFD) analysis, supplied by the manufacturer. The CFD Analysis Method must be verified by calculations supported by previously completed physical flow distribution tests.

2.3 Strength

2.3.1 The intake assembly shall be designed to a maximum 4.33 psi (0.3 bar) negative pump pressure or differential headloss.

2.3.2 Design stress used for determining strength of the assembly shall be no more than 80% of the published yield strength of the material used. Strength calculations verifying compliance with these criteria shall be provided upon request.

2.4 Construction

2.4.1 The intake screen surface wire shall be Johnson Screens Vee-Wire® number 69.

2.4.2 The surface wire, support beam and stiffener structure shall be an all-welded matrix designed to provide the specific strength with minimal interference with the through screen flow pattern.

2.4.3 End plates and tee body shall be a minimum of 0.105 inches thick. All structural butt welds shall be full penetration fillet welds and shall be the thickness of the thinner component.

2.4.4 The intake shall have a maximum outside diameter of 24.62 inches and a maximum overall length of 88 inches.

2.4.5 Screens for the intakes assembly to be fabricated by the intake manufacture. Intakes constructed with screens fabricated and procured by a third-party manufacture are not acceptable.

2.5 Slot Opening Size

2.5.1 The screen slot size shall be 0.25 in (6.35 mm). The open area for this slot opening shall be 58%.

.1 Slot size shall be controlled and continuously monitored during manufacture.

.2 For slot openings of 0.040” through 0.100” the mean slot size shall be within +/- 0.002” with a standard deviation no greater than 0.002” throughout the assembly.

.3 For slot openings greater than 0.100” the mean slot size shall be within +/- 0.003” with a standard deviation no greater than 0.003” throughout the entire assembly.

2.6 Materials

2.6.1 The main outlet flange shall mate with a 16 inch flange with a flange pattern equal to AWWA C-207, Table 2, Class D.

2.6.2 The air connection shall be 3 inch ANSI Flange

2.6.3 The intake screen material shall be manufactured of 304 stainless steel or Z-Alloy material.

2.6.4 Shall be Z-Alloy. Any alternate copper-based materials must demonstrate a minimum of five (5) years experience showing successful zebra mussel protection. Lack of demonstrated experience or coatings of any kind shall not be acceptable.

3 SCREEN SUBMITTALS

3.1 Shop Drawing

3.1.1 The intake screen manufacturer shall submit:

.1 Drawing(s) showing screen diameter, screen length, assembly length, interface dimensions for outlet and air backwash dimensions, materials of construction and assembly weight.

.2 WPS/PQR

.3 Evidence of a recognized ongoing quality assurance program

.4 Provide supporting flow distribution data where calculations are supported by previously completed physical flow distribution tests. This includes a CFD Analysis of the flow distribution of the screen at the design flow.

.5 NSF 61 Model Number

4 HYDROBURST AIR BACKWASH SYSTEM

4.1 General

4.1.1 The intake screen supplier shall provide, as part of the overall intake screen system, an air backwash system designed to remove debris from the screen surface by delivering a suitable volume of compressed air to the inside of the screen body. The exiting air shall scour the screen surface to maintain adequate design flow and through slot velocity characteristics.

4.2 Products

4.2.1 The Hydroburst air backwash system shall consist of a compressor, control air receiver and control panel as a skid mounted system. One (1) main receiver tank and (1) valve shipped loose for site install. Interconnecting pipe & electrical by installing contractor. Hydroburst must operate without causing any flow interruption.

.1 The compressor shall be a Kaeser rotary screw compressor and shall be sized to recover from each backwash in 15 minutes.

.1 3/60/575V, TEFC 20hp Electric Motor

.2 IP 54 Electrical Enclosure

.3 Belt drive with automatic tensioning

.4 Sound Enclosure - 67 dBa

.5 Ambient Temp (max/min): 115F / 40F

.6 Factory fill of Food grade oil

.2 The receiver shall be a Samuel 1060 gallon receiver, ASME coded for 200 psig, sized for the system piping and to displace **three screen volumes of air at the screen in 3 to 5 seconds** during a backwash to provide suitable debris removal and cleaning. The receiver dimensions will be as per the Contract drawings.

.3 The receiver shall be equipped with a 4 ½ inch isolated pressure gauge, safety valve and automatic drain valve.

.4 The system shall include one Jomar butterfly rated at 200 psi with standard ANSI class 125/150 flanges. There shall be one valve per screen and shall be sized to match the tank flange and the backwash piping.

.1 Seat to flange seal - EPDM

.2 Body Ductile Iron - Epoxy coated finish

.3 Shaft / Disc – Stainless Steel

.4 Spring-Return Pneumatic Actuator

.5 Single Solenoid Control valve with Manual Override

.6 Visual Position Indicator with Limit Switches

4.2.2 Automatic Operation:

.1 The above Jomar butterfly valve(s) shall be provided with a pneumatic actuator with direct mounted solenoid valves, position indicator and position switches.

.2 The system shall include a suitably sized air receiver interconnected and charged by the main receiver to allow valve operation.

.3 A NEMA 4 control panel shall be included that will contain as a minimum, the motor starter for the compressor, control power transformer and a relay logic to perform the specified control functions.

.4 The controls shall allow timed automatic or manual initiated air cleaning cycles. A cycle consists of cleaning all intake system screens.

.5 The control system included shall allow a full week duration of programmed Hydroburst cycles.

.6 All operator / indicators will be 22 mm in size. All indicators will be LED type

.7 Control Panel, NEMA 4 Enclosure with:

.1 Intertek Labeled for UL508a assembly

.2 Lockable Disconnect w/Type J Fusing

.3 7-Day Programmable Timer

.4 System On-Off Selector Switch

.5 Cycle Start Push Button

.6 Digital pressure controller with readout

.7 System Power On Pilot Light

.8 Low Air Pressure Alarm Pilot Light

.9 Adequate Air Pressure Pilot Light

.10 Cycle in progress Pilot Light

.11 Relays

.12 Auxiliary Contacts

.13 Compression Type Terminal Blocks capable of 1 #10 wire or 2, #12 wires.

.14 Isolated SCADA / PLC Output Contacts (Yellow in color)

.1 - Cycle Start – Option for remote signal to initiate an air burst cycle

.2 - Valve Open

.3 - Valve Closed

.4 - Adequate Air

.5 - Low Air Pressure

4.2.3 Interconnecting piping between the intake screen assembly and the Hydroburst System is by others. All interconnecting wiring to automated valving and power connections is done by others.

4.3 Shop Drawing and Manuals

4.3.1 Included in the intake screen submittals shall be all associated Hydroburst equipment catalog information, system sizing criteria and drawings. All dimensional and operational information will be provided. All interconnecting wiring and piping information will be included.

4.3.2 An electronic version of the O&M will be provided.

4.4 Commissioning and Training

4.4.1 Manufacture shall provide a field service representative for one trip consisting of 2 days. The first day will be dedicated to commissioning the Hydroburst unit and the following half day will be for operator training.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers the furnishing and installation of the Stationary Screens in the LLPS screen wells and appurtenances.

1.2 General Description

1.2.1 The Stationary Screens will be designed to fit the new screen wells structure and capture / retain debris from the raw water/lake water larger than the mesh opening. The lake water will be pre-screened at the intake screen assembly. The flow pattern will be directly perpendicular to the screen and each channel will include guides to accommodate a single Stationary Screen.

1.2.2 Each channel will include one (1) Stationary Screen, which will continuously screen the flow. When a Stationary Screen is fouled and requires cleaning, the channel is first isolated. The Stationary Screen may then be removed and transported to the designated cleaning area for rinsing. Once cleaned, the Stationary Screen is reinserted, the flow resumed and the next channel requiring a Stationary Screen to be cleaned may be isolated. The process is repeated until all Stationary Screens are cleaned returned to the corresponding channel location.

1.2.3 The total quantity of screens is equal to the number of channels/screen wells – two (2). The Stationary Screens for each channel will be identical. Each Stationary Screen will consist of a Main Frame, Screening Element, Debris Scoop and Guide Rollers. A set of guides is to be installed in each channel.

1.2.4 The Main Frame will consist of heavy formed plates / structural shapes, designed to withstand the indicated clean and design static head loss. The Screening Elements will be the indicated opening and type per the data tables and be securely fastened to the Main Frame with suitable Clamping Strips. Side seals will be included, based on mesh aperture. Each Stationary Screen will include a minimum or one (1) Debris Scoop, fitted with drain holes, to capture debris that may slide down the face of the screen upon removal. The downstream sides of the screens will be fitted with Wear Pads as well as Guide Rollers to aid in preventing binding on insertion or removal. Each screen will be split into 2 equal height sections to accommodate overhead lifting height. The entire screen is lifted until the upper section is above deck. The lower section is pinned in place, the upper section wedge pins removed, and the upper section transported to the cleaning / rinsing area. The operator then transports the lower section to the cleaning area and the process is reversed for reinsertion.

1.2.5 Guides are be inserted into the civil works in each channel to accommodate the Stationary Screens. Handrails or other protective barriers are to be supplied and installed by owner / contractor / others, to prevent inadvertent access to the channels.

2 PRODUCTS - STATIONARY SCREENS

2.1 General Data

2.2 Refer to the contract drawings for dimensions of the screen wells. Contract drawings will take precedence over specifications.

Number of Stationary Channels & Guide Sets	Two (2) & Two (2) (100% redundancy)
Quantity of Stationary Screens	Two (2)
Channel Width	2.00 m
Channel Depth	6.17 m
Design Maximum Static Differential	1.00 m
Stationary Screen Width (nominal)	2.00 m (2.10 m over frame)
Stationary Screen Height (nominal)	4.11 m (4.27 m over lifting eyes) Split in 2 sections of +/- 2.05m high + lifting eyes
Type of Screening Media	Woven wire mesh
Screen Opening Size & Wire Diameter	5 mm
Type of Guides	Embed Angle
Guides Supplied [yes / no]	Yes
Type of Lifting Eyes / Lugs	Exposed Lifting Eyes
Debris Scoop Depth x Width / Perforation Size	50mm x 100mm / 6.35 mm
Estimated Weight – Assembled Screen*	497 kg

2.3 Materials of Construction

Item	Material
Main Frame	ASTM A-240 / 276 Gr. 304/304L Stainless Steel
Screening Panels	Gr. 304 Stainless Steel
Side Seals	Neoprene
Clamping Strips	Nylon
Wear Pads	Nylon
Debris Scoop	ASTM A-240 / 276 Gr. 304/304L Stainless Steel
Guide Rollers	Polypropylene
Guide Roller Axles	ASTM A-276 Gr. 304/304L Stainless Steel
Screening Panel Fastener Nut / Bolts	Gr. 18-8 Stainless Steel

Embedded Guides	ASTM A-240 / 276 Gr. 304/304L Stainless Steel
Guide Anchors (affixed to embedded guides)	ASTM A-276 Gr. 304/304L Stainless Steel

2.4 Protection/ Coatings

2.4.1 Items of stainless steel, brass, bronze, high density plastic or other corrosion resistant materials will not receive additional coatings. Other materials listed below will be protected or coated as indicated below:

Item	Protection
Main Frame	Stainless Steel – None
Screening Panels	Stainless Steel – None
Side Seals	Neoprene – None
Clamping Strips	Nylon – None
Debris Scoop	Stainless Steel – None
Guide Rollers	Polypropylene - None
Guide Axles	Stainless Steel – None
Screening Panel Fastener Nut / Bolts	Stainless Steel – None
Embedded Guides & Anchors	Stainless Steel – None

2.5 Packing

2.5.1 The Stationary Screens will be prepared as follows for shipment via ground on open flatbed trucks as follows:

.1 The Stationary Screens will ship in sections, fully assembled, protected and banded to skids.

.2 The Embedded Guides will be bundled and banded in sections for site installation.

2.6 Acceptable Manufacturers

2.6.1 Acceptable manufacturers:

.1 Jonhson Screens

.2 Approved equivalent

3 EXECUTION

3.1 Installation

3.1.1 Carry out stationary screen installation in accordance with screen manufacturer and retain the services of a manufacturer representative to assist with the installation of the screen segments.

3.1.2 Obtain written confirmation from the manufacturer representative that the screens have been installed in accordance with manufacturer recommendations and are ready and safe for operation.

END OF SECTION

SAMPLE PUMP DATA SHEET

Fill out the following tables and submit them with the pump shop drawings.

1.0 GENERAL

1	Pump Name	
2	Pump Location	
3	Tag numbers	
4	Number of Pumps	
5	Pump Unit Application	
6	Pit Dimensions	
7	Chamber Invert Elevation	
8	Chamber Top Elevation	
9	Total Discharge Pipe Length	

2.0 OPERATING ENVIRONMENT AND SITE DETAILS

1	Degree of Pump Unit Immersion	
	Submerged	
2	Service Conditions	
	Liquid Pumped	
	Pumping Temperature	
	Specific Gravity at 10°C	
	Viscosity	
	pH	
3	Ambient Air Temp/RH (-10°C-40°C/<100%*)	

3.0 PERFORMANCE SPECIFICATION

1	Operating Speed (rpm)		
	Maximum Rated Speed		
	Actual		
2	Hydraulic Performance at the Guarantee Point (GP)		
	Flow rate (L/s)		
	Static head (m)		
	Dynamic head (m)		
3	System Data		
	Reference for data/curve		
	Min/max static head (m)		
4	Q (GP)/Q (BEP) – Upper and Lower Limits (%)		
	Limits		
5	Overall Efficiency		
	At the GP		
	At the maximum flow		
6	Motor Power Input (kW)		
	At the GP		
	At the maximum flow		
	Maximum		
7	Performance at Closed Valve		
	Closed valve head (m)		
	Max. operating time (s)		
8	NPSHa		
	At the GP		
	At the maximum flow		
9	NPSHr		
	At the GP		
	At the maximum flow		
	NPSH safety margin at the maximum flow (m)		
10	Solids Handling (mm)		

4.0 DESIGN SPECIFICATION

4.1 General

4.1.1 Weights and Lifting Arrangements

1	Weights	
	Total (kg)	
2	Type of Lifting Point Provided	
	Eye bolts	
	Handle	
	Other (specify)	
3	Lifting Handle Material	
4	Lifting System Required (Y/N)	Y
5	Reference for Purchaser's Particular Specification	
6	Insulation Class	

4.1.2 External Corrosion Protection

1	Coating Specification

4.1.3 O & M Manuals

1	Type Required	
	Supplier's standard	
	Purchaser's standard (specify reference)	

5.0 Guide System

1	Required Length of Guide System (m)	
2	Guide Tube Material	

6.0 Pump Construction

6.1 Pump Casing

1	Material

2	Outlet (mm)	
	Nominal bore	
	Flange type	
3	Renewable Wear Parts	
	Required/fitted (Y/N)	
	Material(s)	
4	Externally Adjustable Casing/Impeller Clearance Provided (Y/N)	
5	Coatings	
	Required/provided (Y/N)	
	Specification	
	Thickness (microns)	
	Expected efficiency increase (%)	
	Expected life (yrs)	
6	Access For Inspection/ Clearance of Blockages Required (Y/N)	

6.2 Impeller

1	Impeller Type & Material	
	Type	
	Material	
	Number of Blades	
2	Direction of Rotation of Impeller (viewed from the Non-Drive End)	
3	Impeller Dimensions (mm)	
	Actual diameter fitted	
	Maximum diameter	
4	Method of Securing Impeller to Pump Shaft	
	Key	
	Bolt	
	Conical taper	
	Other (specify)	
5	Method of Balancing (Single Vane and Screw Centrifugal Impellers)	

6	Wear Rings	
	Required/provided (Y/N)	
	1. Fixing Method	
	Material(s)	

6.3 Pump Shaft

1	Material

6.4 Pump Shaft Seal

1	Seal Details	
	Type	
	Manufacturer	
	Material	
	Mechanical	

6.5 Bearings and Bearing Lubrication

1	Minimum L_{10h} Life at the GP	
2	Actual L_{10h} Life at the GP	
	Upper bearing	
	Lower bearing	
3	Bearing and Lubricant Details	
	Manufacturer	
	Designation	
	Lubricant	

7.0 Drive and Motor

7.1 Electrical Supply

1	Drive Type	Constant Speed
2	Supply Voltage (, 3 phase, 3 wire, 60 Hz)	
3	Rated Current	
4	Direction of Rotation	

7.2 Duty and Rating

1	MC Rating (kW)	

7.3 Starting

1	Method of Starting	
	Direct-on-line	
	Star-delta	
	Auto-transformer	
	Reduced current	
	Other (specify)	
2	Starting Duty (starts/hr)	
	Maximum required	
	Maximum achievable	
3	Full Load Current (A)	
4	Starting Current (A)	
	Maximum permitted	
	Actual (if > 6.5 x FLC)	

7.3 Enclosure and Cooling

1	Submersion Depth	
2	Method of Cooling	
	Proprietary coolant	
	Air	
	Pumped liquid	

8.0 Cables and Connectors

8.1 Cables and Connectors

1	Cable Length	
2	Fitted to Cable (Y/N)	

8.2 Cable Support System (If Required)

1	Required (Y/N)	

9.0 Sensors

1	Type of Sensor	
	Leakage	

	Connection to LP	

10.0 TESTS

Type of Test	Test Location		Witnessing Requirements		Test Standard	Acceptance Levels & Tolerances
	Factory	Site	(Y/N)	Notice (Days)		
Hydrostatic						
Acceptance (Q, H, Power, Effy)						
NPSH						
Noise						
Thermodynamic						
Control Panel						

1 GENERAL

1.1 General Description

1.1.1 The Contractor shall supply materials, equipment and labour to furnish, install and test the pump system complete with the pump, motor, piping, valves and accessories, as indicated on the contract drawings and following the instructions specified by the manufacturer. The pumping system includes four (4) jet pumps (sample pump) as indicated on the contract drawings and additional an identical shelf spare sample pump.

1.1.2 The Contractor shall ensure that the sample pump and motor is properly installed and checked in accordance with the standard of the Hydraulic Institute and there shall be no pipe strain transmitted to the pump casing.

1.1.3 All components of the product in contact with water shall have NSF61 certification

2 PRODUCT

2.1 General

2.1.1 The pump shall be a shallow well jet pump, suitable with following characteristics and materials of construction:

2.1.2 Pump volute shall be of Ductile Iron or Cast Iron design for mounting directly in a pipeline. Pumps shall be also available with various hanging installation options. Pump shall have suction and discharge of the same size. Pump volute shall allow for 175 psi working pressure with threaded connections for 250 psi working pressure. Pump shall have a back pull-out design to avoid disassembly of the pipeline during pump maintenance.

2.1.3 Pump design shall include a mechanical seal with stainless steel (ASTM 303) metal parts and spring, NFS 61 compliant materials, Buna-N elastomers, Ceramic seat and Carbon washer. A bypass line must be provided between the seal faces and the discharge flange to assure adequate venting of the seal. Pump shall be equipped with a stainless steel or carbon steel shaft.

2.1.4 Pump motor bracket shall accommodate most common NEMA rated motor configurations in accordance with the latest NEMA Standards and shall have a sufficient horsepower rating to operate the pump at any point within the manufacturer’s recommended operating range on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor, regardless of service factor. The motor shall have a service factor of at least 1.15. The service factor is reserved for variations in voltage and frequency. Motor bracket shall be machined rigid cast iron motor.

2.1.5 If applicable the sample piping off the sample pump discharge shall be fitted with a pressure reducing valve and flow control valve (i.e. needle valve) as required by the receiving chlorine analysers outlined in Section 13567.

2.1.6 The sample pump will draw raw water from the lake at the intake mouth for water quality analysis. The flow will pass through various sensors (analyzers) and will be recycled back to the low lift wells.

2.1.7 Pump design parameters indicated in the following table. Design report and drawings take precedence over specifications.

Parameter	Specification for Typical Pump
Sample Stream Max Requirements prior to water quality sensors/analyzers	60L/hr at 15 psi
Ideal Operational Range at full speed	60 L/hr
Sample Pump	
VFD/Constant Speed	Constant
Duty	Continuous
Maximum Motor Size	0.5
Voltage, Frequency, Phases	115/230 v, 60hz, 1 ph (will only be running at 115V)
Minimum Hydraulic Efficiency at Duty Point	80%
Liquid Temperature Range	0.5 – 25 C
Max. Chlorine Concentration	4 mg/L
Suction/Discharge	25mm
Minimum lift	3.40 m
Maximum lift	5.83 m
TDH	18 m

2.1.8 The Contractor shall submit a completed **Technical Data Sheet,** provide manufacturer technical data sheets including dimensional drawings and pump curves.

2.1.9 Accepted Manufacturers:

.1 Goulds Water Technology

.2 Flowserve

.3 KSB

.4 Approved Equivalent

3 EXECUTION

3.1 GENERAL

3.1.1 Pump manufacturer warranty shall be for a period of one (1) year from the date of installation or start-up, or for eighteen (18) months after the date of shipment, whichever comes first.

3.1.2 Pump(s) shall be manufactured, assembled and tested in an ISO 9001 approved facility.

3.1.3 Pumps must be compliant with the Department of Energy (DOE) New Standard (PEI of 1 or less) and include all new mandatory information on the nameplate

TECHNICAL DATA SHEET (SEC11422-S1)

TO BE COMPLETED AND SUBMITTED WITH TENDER

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This Section covers the Work associated with the following equipment in the Chemical Room of the Blind River Low Lift Pumping Station (LLPS).

.1 One complete pre-packaged, self-contained, and fully assembled and tested feed equipment skid package for Sodium Hypochlorite chemical including 2 dosing pumps (one duty, one standby) and control panel

.2 Chemical piping, valves and accessories for sodium hypochlorite injection as shown on the contract drawings.

.3 One Sodium Hypochlorite storage tank.

1.2 Related Sections

1.2.1 Division 1 - General Requirements

1.2.2 Division 11 - Equipment

1.2.3 Division 13 - Instrumentation and Control

1.2.4 Division 15 - Mechanical

1.2.5 Division 16 - Electrical

1.3 References, Codes And Standards

1.3.1 American Society of Testing Materials (ASTM).

1.3.2 D638 Tensile Properties of Plastics

1.3.3 D883 Standard Definitions of Terms Relating to Plastics

1.3.4 D1505 Density of Plastics by the Density-Gradient Technique

1.3.5 D1525 Test Method for Vicat Softening Temperature of Plastics

1.3.6 D1693 ESCR Specification Thickness 0.125" F50-10% Igepal

1.3.7 F412 Standard Terminology Relating to Plastic Piping Systems

1.3.8 ANSI Standards: B-16.5, Pipe Flanges and Flanged Fittings

1.3.9 ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure).

1.3.10 NSF/ANSI Standard 61, AWWA – Drinking Water System Components

1.3.11 ASTM D-1998, Standard Specification for Polyethylene Upright Storage Tanks site operating and water quality conditions shall be assumed for all design calculations:

1.4 Site Conditions

1.4.1 The following site operating and water quality conditions shall be assumed for all design calculations:

.1 40°C maximum/5°C minimum ambient air temperature

.2 30°C maximum/0°C minimum chemical temperature

.3 95% maximum relative humidity (non-condensing)

1.4.2 Refer to the Contract Drawings for further details.

1.5 Conditions of Service

1.5.1 Provide equipment and appurtenances suitable for handling 12% Sodium Hypochlorite with specific gravity 1.10 to 1.25 at 20°C in solution with pH>12.

1.6 APPURTENANCES, FittINGS AND ACCESORIES

1.6.1 All appurtenances, fittings, and accessories necessary for the proper functioning of all the equipment or reasonably inferable from the drawings shall be supplied and installed with the equipment, whether indicated on the drawings or specified herein, or not.

1.7 Submittals

1.7.1 In accordance with Section 01330 - Submittals

1.7.2 The shop drawing submission shall include, but not be limited to, the following:

.1 Dimensional chemical system panel layout.

.2 Provide pump output curves for each pump.

.3 Provide basic design details for each piece of equipment, including sizing calculations, control panel layout, control schematics and wiring diagram(s).

.4 Detailed engineering drawings of each tank with port sizes, connections and locations.

.5 Data confirming that the material of equipment is resistant to the chemicals used.

.6 For each major component include the name of Manufacturer, type and model of equipment and net weight.

.7 Descriptions of the materials of construction of the major components. Provide sufficient detail to show the general construction pertinent to the proper review of the equipment.

.8 A precise list of all electrical requirements for the equipment including all controls, monitoring equipment and instruments shall be given including all power characteristics and materials of construction.

.9 The Supplier shall indicate a list of spare parts, which they would recommend be purchased and individual prices for each item.

.10 All ancillary equipment to be provided by the Supplier shall be listed.

.11 Special accessories or tools for the adjustment or removal of parts required for any piece of equipment shall be listed and furnished as part of the supply.

1.8 Maintenance Data

1.8.1 Refer to Section 01780 - Closeout Submittals

1.9 Measurement and Payment

1.9.1 Work outlined in this section is included in the lump sum tender price.

2 PRODUCTS

2.1 General

2.1.1 Provide and install chemical metering systems and storage tanks as indicated on the Drawings.

2.1.2 Provide one (1) chemical feed system (c/w two pumps) for sodium hypochlorite that is capable of operating 24 hours per day 365 days per year.

2.1.3 One (1) high density polyethylene piping panel with fiberglass supports, pre-mounted, pre-piped, pre-wired and 24-hours pressure tested with local and remote control.

2.1.4 Chemical piping, chemical carrier piping and injection quill for the injection of sodium hypochlorite.

2.1.5 Provide one (1) single wall storage tank suitable for 12% Sodium Hypochlorite liquid.

2.1.6 The input power for the chemical feed system shall be 120 VAC, 1-phase via wall- mounted 120 VAC receptacles as per the supplier's requirements.

2.2 Metering Pumps

2.2.1 The following table lists the conditions of service, the number of pumps required, flow and head conditions control and additional features.

Pump Tag No.	Pump Qty.	Capacity (L/h)	Discharge Pressure (psi)	Location of Pumps/ Dosing Point	Control Feature
DP0901 DP0902	2 (1 duty, 1 standby)	3.0	30	Chemical Room / Raw water intake screen	4-20mA control from SCADA, 4-20mA feedback to SCADA via pump control panel

2.2.2 The diaphragm metering pumps will include, but not limited to the following:

.1 Chemical metering pumps shall be Mechanically Actuated Diaphragm, positive displacement, motor driven, metering pump.

.2 Chemical metering pump shall be driven by a microprocessor-controlled stepper motor providing a minimum of 1000:1 turndown ratio. The stepper motor is to be coupled to a flat, PTFE diaphragm via a gear assembly. The drive assembly shall be a maintenance free design.

.3 The pump shall have adjustable stroke length with accurate repetability from 20% to 100%.

.4 The liquid end & valve design shall provide for ease of maintenance. Ball checks shall be cartridge type design.

.5 The pump shall be able to detect actual flow through the dosing head to monitor the dosing process without need for additional measuring equipment.

.6 The pump shall be able to compensate automatically for pressure fluctuations atn the injecting point, maintaining the flow rate constant.

2.2.3 The enclosure will include, but not limited to the following:

.1 Drive mechanism and microprocessor shall be housed in a corrosion resistant, plastic UV stabilized enclosure.

.2 The pump design shall include provisions for optional positioning of the control interface/display, for right/left side and front mounting.

.3 Pump enclosure rating shall be to IP65 and NEMA 4X standards.

.4 The pump design shall include an integral removable click stop mounting plate, to allow for flat base or wall mounting.

2.2.4 The pump drive will include, but not limited to the following:

.1 An integral variable speed stepper motor shall be used to ensure the pump discharge phase extends throughout the full period between suction intervals.

.2 Variable frequency drives shall not be accepted.

.3 The motor shall be integral, supplied with power cord and plug.

.4 The drive mechanism shall not require regular field service or external lubrication.

2.2.5 The interface will include, but not limited to the following:

2.2.6 User interface/display shall be backlit LCD with selectable on-site positioning for either side or front mounting.

2.2.7 The interface shall provide a selection of metered output to be displayed in litres per hour (l/h) or gallons per hour (gph). Pumps displaying percent (%) of output only will not be accepted.

2.2.8 The interface should include a turn and push knob for easy navigation.

2.2.9 The interface menu shall provide easy navigation of all configuration and operational functions.

2.2.10 The interface shall include a lock function to protect against unauthorized changes.

2.2.11 A built in counter shall be included to provide a running total of, accumulated strokes, cumulative hours of operation and dosing flow.

2.2.12 A priming button shall be provided on the interface. The priming button shall initiate a time selectable prime cycle operating at full capacity without need of attenuating the pumps output setpoint.

2.2.13 A system of white, red, yellow and green LCD shall indicate pump status and alarm conditions.

2.2.14 The liquid end will include, but not limited to the following:

.1 The process diaphragm shall be PTFE, PTFE coated diaphragms are not acceptable.

.2 Head and valves body material shall be (PVDF) with (Ceramic) ball material.

.3 Wetted gasket material shall be (FKM-For Sodium Hypochlorite) Suction and discharge valve design shall incorporate double ball arrangement. Spring-loaded valves shall be available as an option. Direction of flow shall be clearly marked on each check valve to ensure correct installation.

.4 Head design shall incorporate integral priming valve.

.5 A back-plate with separation chamber shall have a safety lip seal and drain hole.

.6 Metering Pump Control

.1 Analog: Pump shall include direct interface provisions for analog control. Both direct and reverse acting 0/4-20mA input configurations are to be acceptable inputs. The menu configuration shall permit pump maximum output multipoint scaling. The pump shall include a local alarm for loss of input signal.

.2 Pulse: The pump shall include direct interface provisions for pulse output devices. In pulse control mode, the pump shall be configured to deliver a volume of product per incoming pulse. The pump speed shall attenuate the delivery rate based on the frequency of pulses generated by the external device.

.3 Batch: In batch mode the pump shall respond to deliver a menu configurable quantity of liquid after receiving a remotely provided contact input.

.4 Cycle timer: The configuration menu of the cycle timer shall permit the user to prescribe batch volume, timed sequence start point and the time between each successive timed delivery cycle.

.5 Week timer: The pump shall be equipped with a real-time clock and a seven-day internal week timer. The configuration menu shall permit the user to prescribe up to 16 procedures with batch volume, dosing time, start time and weekdays.

2.2.15 Acceptable suppliers are as follows:

.1 ProMinent Fluid Controls

.2 Grundfos

2.3 Injection Unit

2.3.1 PVC injection quill with SS isolation ball check valve to be provided for the chemical injection point. Proposed injection quill length to be suitable for proposed pipe diameter (refer to drawings), which shall be included in the shop drawings to be reviewed by the Engineer.

2.3.2 Acceptable manufacturer:

.1 SAF T FLO Chemical Injection Model EB or pre-approved equal.

2.4 Storage Tank

2.4.1 Provide one (1) tank for sodium hypochlorite.

2.4.2 Chemical Storage Tank shall be designed in accordance to ASME D638 Specifications, ANSI Standards B-16.5 Pipe Flanges and Flanged Fittings, and UBS Code: Uniform Building Code.

2.4.3 The tank shall apply to NSF/ANSI Standard 61, AWWA - Drinking Water System Components.

2.4.4 Tank Design requirements:

Parameter	**Sodium Hypochlorite**
Number of Tanks	1
Minimum Capacity	1,360 L
Maximum Diameter	1.2 m
Maximum Overall Height	1.3 m
Tank Material	High-Density Crosslinked Polyethylene
Construction	Rotationally molded in one piece

Ball Valves	Standard PVC, true union ends, PTFE seals

2.4.5 Acceptable manufacturer: ACO Container Systems, Model CT-300-CH or pre-approved equal

2.4.6 Tanks to include the connections listed below.

Tank Port	Number of Ports	Type/Location	Size	Connection Details
Chemical suction	1	Threaded/Top of the Tank	3/4” NPT	Provide compression style fitting for sealing the tubing (e.g. PVC strain relief connector). Provide a threaded plug for the suction port not in use.
Chemical filling	1	Flanged/Top of the Tank	25mm	Provide a cam lock fitting.
Vent	1	Flanged/Top of the Tank	100mm	As per Contract Drawings
Overflow	1	Flanged/Lateral Top of Tank (above 100% level)	100mm	As per Contract Drawings
Ultrasonic Level Sensor	1	Flanged/Top of the Tank	100mm	Riser with flange for ultrasonic level control

2.4.7 The ports should accommodate the pipe sizes shown in the Contract Drawings. All connections should be airtight.

2.4.8 Tanks to include molded-in clear strips (entire tank height), graduated in “Litres”; the strips should be positioned to monitor tank content.

2.5 CHEmical system valve schedule

2.5.1 Provide chemical system valves in accordance with the Chemical Valve Schedule provided in Sec11540-S1.

3 EXECUTION

3.1 Installation and Inspection

3.1.1 The chemical dosing pump, storage tank and other chemical system shall be installed as indicated on the Contract Drawings, in accordance with the Manufacturer's recommendations and as approved by the Engineer.

3.1.2 The Contractor shall provide a dual containment clear HDPE pipe where the pipe runs outside the containment in the building.

3.1.3 Refer to Section 01850 - Demonstration and Training.

3.1.4 Provide the services of a factory trained representative to inspect, operate, test, adjust, and troubleshoot the installation.

3.1.5 Prior to start-up, a factory trained service representative employed directly by the Manufacturer shall inspect, operate, test, adjust and troubleshoot the installation. This work will ensure that the equipment has been installed properly, lubricated adequately, checked for soundness and ready to be started.

3.1.6 The factory trained representative, mentioned above, will certify that the equipment is ready for operation before use.

3.1.7 In addition, the factory trained representative shall instruct the owner's operation personnel in the proper operation and maintenance of the equipment supplied.

3.1.8 Provide for additional supervision of installation by equipment Supplier as required.

3.1.9 Arrange with the Engineer a mutually agreeable date when the representative should be on site.

3.1.10 Submit a report, signed by the Manufacturer's representative, describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment conforms to all specifications.

3.1.11 Inspection to include checking for:

.1 Cracks and other damaged or defective parts.

.2 Completeness of installation as specified and as recommended by the Manufacturer.

.3 Correctness of setting, alignment and relative arrangement of various parts of the system.

3.2 Mechanical Testing and Certification

3.2.1 After start-up and prior to final acceptance, the Contractor shall conduct Engineer-witnessed performance tests on the equipment.

.1 Prepare calibration curves for each of the pumps at 8 mA through 20 mA flow signals using a minimum of 16 different data points.

.2 Prepare tables to record the test results for each calibration curve. Have table reviewed by the Engineer prior to testing. Submit the results to the Engineer for review.

.3 Conduct the calibration curve testing using the intended design flow rates.

3.2.2 A field service representative will start the chemical dosing pump to perform all mechanical functions that the pump is designed to perform. Tests will be scheduled with the Engineer at least two (2) weeks prior to the planned test date.

3.2.3 The factory trained representative shall submit to the Engineer a written report stating that the equipment has been checked and is suitable for operation.

3.2.4 Hydrostatic test: Following installation of storage tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 24 hour and inspected for leaks.

3.3 Supervision of Installation and Commissioning

3.3.1 Test and commission the equipment in accordance with section 01800 - Start-up and Commissioning.

3.3.2 At the completion of satisfactory installation, each unit shall be started by the General Contractor under the supervision of the Supplier and in cooperation with the plant operations staff. All controls and alarms shall be checked and tested to ensure proper control and equipment protection.

3.3.3 Equipment will only be accepted after receipt of a satisfactory report submitted by the Manufacturer's representative(s).

3.3.4 When the installation and operation is satisfactory, the Supplier shall certify in writing to the General Contractor that the unit is available for operation.

3.3.5 Modify or replace equipment or materials failing required tests.

3.3.6 Perform additional testing required due to changes of materials, and/or failure of materials or construction to meet specifications at no extra cost to the Owner.

3.3.7 As a minimum, allow the following:

.1	Installation Inspection	1 trip, 1 day
.2	Startup/Commissioning	1 trip, 2 days

3.4 Storage

3.4.1 Prior to the installation, the chemical dosing pumps and systems and accessories should be protected and stored indoors in a dry area, in accordance with the Manufacturers recommendations.

3.5 Maintenance

3.5.1 Provide maintenance on Supplier's equipment as required by the Supplier from the date of delivery to the initial start-up.

3.6 Training

3.6.1 The manufacturer of the chemical systems shall furnish the services of a competent and experienced operator of the equipment, who is directly employed by the manufacturer, to

instruct the Owner's operating personnel in the proper operation and maintenance of the equipment. In accordance with Section 01850 - Demonstration and Training.

3.7 Warranty

3.7.1 Each unit shall be new and shall carry the full Manufacturer's warranty on parts, service, and performance. The warranty shall include replacement of all defective equipment and shall extend two (2) years beyond date of completion.

3.7.2 Corrective Work. Any location where corrosion is evident shall be considered a failure of the material or the protection system. Before starting corrective work, the Manufacturer shall submit to the Engineer for review an analysis of the cause of the failure and details of the proposed corrective work. The Manufacturer shall make repairs acceptable to the Engineer at all points where failures are observed within the Warranty Period.

3.7.3 Inspection. Each unit shall be inspected at the end of the warranty period by representatives of the Owner, the Engineer, and the Manufacturer to identify any failures that may have occurred. The Manufacturer shall establish the date of each inspection and shall notify the Owner at least 30 days in advance. The scheduled inspection shall not relieve the Manufacturer from the obligation to perform corrective work whenever needed.

3.7.4 The Manufacturer shall prepare and deliver to the Owner an inspection report covering each inspection, indicating the number and type of failures observed, material and part where materials have failed, the percentage of the surface area where corrosion protection system failure has occurred, and the names of the persons making the inspection. Colour photographs illustrating each type of failure shall be included in the report.

END OF SECTION

1 GENERAL

1.1 Intent of Section

1.1.1 This section covers the supply, delivery, supervision of installation and commissioning of chemical feed piping and accessories, complete as specified herein and as shown on the Contract Drawings. The work includes, but is not limited to, the following:

.1 Sodium hypochlorite feed system (chlorination system).

1.1.2 The Contractor is responsible for overall coordination of pipes, valves and fittings to ensure their compatibility with the proposed works.

1.2 Related Sections

1.2.1 Division 1 – General Requirements

1.2.2 Section 11000 – Equipment General Requirements

1.2.3 Section 11090 – Identification and Labelling

1.2.4 Section 11530 – Chemical Metering System and Storage

1.2.5 Division 15 – Mechanical

1.2.6 Division 16 – Electrical

1.3 Site Conditions

1.3.1 The following site operating and water quality conditions shall be assumed for all design calculations:

.1 40^0C maximum/+5^0C minimum ambient air temperature

.2 30^0C maximum/0^0C minimum chemical temperature

.3 95% maximum relative humidity (non-condensing)

.4 Elevation: As per shown on Contract Drawings

1.3.2 Refer to the Contract Drawings for further details.

1.4 Dimensions

1.4.1 Prior to ordering materials and proceeding with the work, check and confirm that the dimensions indicated on the Contract Drawings agree with the dimensions of equipment specified.

1.4.2 Notify the Engineer of any discrepancy in dimensions and obtain clarification. Correct the dimensions as instructed.

1.5 Shop Drawings

1.5.1 Submit the Shop Drawings for review in accordance with Section 01330 – Submittal Procedures.

1.5.2 The shop drawing submission shall include, but not be limited to, the following:

.1 General dimensioned layout and materials list for all valves.

.2 Summary list showing valve tag numbers, size type of operator, valve class, location, motorized operator number, pipe system including pipe schedule, materials.

.3 Submit Manufacturer's catalogue literature indicating the valves, bends, couplings, cocks, fittings, pipes, gaskets and other required materials.

.4 Descriptive material in sufficient detail to show the general construction pertinent to the proper review of the equipment.

.5 The Supplier shall indicate a list of spare parts, which he/she would recommend be purchased and individual prices for each item.

.6 All ancillary equipment to be provided by the Contractor shall be listed.

.7 Special accessories or tools for the adjustment or removal of parts required for any piece of equipment shall be listed and furnished as part of the supply.

1.6 Maintenance Data

1.6.1 Refer to section 01780 – Closeout Procedures

2 PRODUCTS

2.1 Chemical Feed Pipe Fitting Assembly

2.1.1 General - Supply all pipes, valves and fittings of the materials, size, classes and types as shown on the Contract Drawings and as specified herein. All piping, cables, valves and accessories shall be compatible with the chemical being conveyed.

2.1.2 PVC Pipes and Fittings

.1 The Contractor shall supply and install PVC piping as shown on the drawings and/or as specified herein. Pipe sizes shall be determined by the metering pump supplier if not specified on drawings. PVC piping systems conveyed liquids may include but are not limited to:

.1 Sodium Hypochlorite (up to 40% solution)

.2 PVC piping and fittings where indicated on the drawings shall conform to CSA B137.3 and shall be Schedule 80. Fittings shall be socket type and the socket ends are to conform to ASTM D-2467. Provide all the fittings and other ancillary items as required in order to fabricate the pipe systems to the intent of the drawings. PVC pipe fittings shall be solvent welded unless otherwise indicated. Although not specifically detailed on the drawings, the welded PVC piping systems shall be provided with sufficient

unions to enable easy dismantling of the pipework, particularly where pipes pass through walls or other physical barriers.

.3 All pipe and fitting joints to be socket weld type or flanged.

.4 Threaded fittings to be approved by Engineer before assembly.

.5 All piping shall be provided with suitable drainage and vents and be designed to provide complete drainage of both the primary and secondary systems through valve ports.

.6 Acceptable PVC pipe and fittings suppliers are:

.1 IPEX Inc.

.2 George Fischer

.3 Chemline Plastics Ltd.

2.2 Valves

2.2.1 Valving for the chemical suction/discharge piping shall be as follows:

.1 Ball valves shall be PVC compound, true union ball valves with Viton seals, Teflon ball seats with socket weld type 21 ends.

.2 Acceptable suppliers:

.1 Chemline

.2 George Fisher

2.2.2 The following schedule is to establish a quality basis and product type. The schedule is based on Chemline products but equivalents such as those supplied by George Fisher, are also acceptable.

.1 PVC Ball Valves : Chemline Type 21

.2 PVC Diaphragm Valves : Chemline Series DVA

.3 PVC Elbows : Proprietary Item

.4 PVC Tees : Proprietary Item

.5 PVC Y-Strainers : Chemline Series YST

.6 PVC Foot Valves : Chemline Series FVA

.7 PVC Gate Valves : Chemline Series CGA

.8 PVC Swingcheck Valves : Chemline Series SCA

.9 PVC Ball Check Valves : Chemline Series BCA

.10 PVC Globe Valves : Chemline Series GVA

.11 PVC Pressure Relief Valves : Chemline Series PRA

.12 Gauge Isolators : Chemline Series GI

.13 Electric Actuators : Chemline Series Q, A and V

.14 Plastic Pneumatic Actuators : Chemline Series PP

.15 Plastic Butterfly Valves : Chemline Series Type 57

2.2.3 Seats and seals shall be as recommended by the valve manufacturer and are to be compatible with the medium in the pipe.

2.3 Chemical Valve Schedule

2.3.1 The Chemical Valve Schedule is included to assist the Tenderer. The schedule does not purport to be fully complete and the Tenderer is to refer to the Contract.

2.3.2 The Chemical Valve Schedule is provided in Section 11540-S1.

2.4 Calibration Cylinder

2.4.1 Provide calibration column as indicated on the Contract Drawings. Calibration column are to be constructed from material suitable for the intended chemical use.

2.4.2 Supply the following graduated columns complete with isolation valve as supplied by Chemline. The column size to be 100 mL.

2.5 Backpressure Valves

2.5.1 Provide backpressure valves for each metering pump and at all chemical pump application points, and as shown on the drawings, with the following features:

.1 Constructed of materials suitable for the chemical conditions of service.

.2 Each individually tagged with reference to the chemical service.

.3 Factory preset at 345 kPa

.4 Pressure gauge and diaphragm to suit.

.5 Screwed end, PVC body, PTFE or EPDM seals.

2.6 Pressure Relief Valves

2.6.1 Provide pressure relief valves for each chemical metering pump with the following features:

.1 Constructed of materials suitable for the chemical conditions of service.

.2 Each individually tagged with reference to the chemical service.

.3 Factory preset at 345 kPa

.4 Adjustable pressure settings

.5 Screwed end, PVC body, PTFE or EPDM seals

.6 Acceptable Suppliers

.1 Chemline

2.7 Pressure Gauges (Chemical Feed Systems)

2.7.1 Chemical feed system pressure gauges shall be liquid filled (glycerine), dial size 63 mm (2½“) with stainless steel case, flangeless lower case type, 6.35 mm (¼”) NPT connection, dual reading gauge in PSI/kPa, pressure range 0 to 160 psi (0 to 1103 kPa).

2.7.2 Chemical feed system pressure gauges shall be supplied with polypropylene gauge isolator.

2.7.3 Acceptable suppliers:

.1 Trerice Model 700LFB-G-25-FSL-250-PSI/kPa-120 complete with gauge isolator.

.2 or approved equal by Ashcroft.

2.8 Basket Strainer

2.8.1 For CEPT ferric chloride and emulsion polymer make-up system.

2.8.2 Provide single and duplex basket strainers, as indicated on the Contract Drawings with the following features:

.1 Constructed of PVC or CPVC materials suitable for the chemical conditions of service.

.2 Each individually tagged with reference to the chemical service.

.3 FRM or EPDM seals.

.4 Rated for 150 psi at 20^0C.

.5 Plastic perforation – 0.8 mm (1/32”).

2.8.3 Acceptable Supplier:

.1 Hayward Flow Control Systems

3 EXECUTION

3.1 Installation and Inspection

3.1.1 The piping, valves, fittings and accessories, shall be installed as indicated on the Contract Drawings, in accordance with the Manufacturer’s recommendations and as approved by the Engineer.

3.1.2 Refer to Section 01820 – Demonstration and Training.

3.1.3 Provide the services of a factory trained representative(s) to inspect, operate, test, adjust, and troubleshoot the installation.

3.1.4 The factory trained representative(s), mentioned above, will certify that the equipment is ready for operation before use. In addition, the factory trained representative(s) shall instruct the owner's operation personnel in the proper operation and maintenance of the equipment supplied.

3.1.5 Provide for additional supervision of installation by Equipment Supplier as required.

3.1.6 Arrange with the Engineer a mutually agreeable date when the representative should be on site.

3.1.7 Submit a report, signed by the Manufacturer's representative, describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment conforms to all specifications.

3.1.8 Inspection to include checking for:

.1 Cracks and other damaged or defective parts. The equipment must be undamaged, without cracks and free of defective parts.

.2 Completeness of installation as specified and as recommended by the Manufacturer.

.3 Correctness of setting, alignment and relative arrangement of various parts of the system.

3.2 Handling

3.2.1 Provide proper equipment and tools for safe and convenient handling and installation of pipes, fittings, valves and other accessories.

3.2.2 Exercise particular care to prevent abrasion of pipe coating.

3.3 Sizing

3.3.1 Supply and install pipes, valves and other fittings according to the sizes indicated on drawings. Where sizes are not clearly indicated, obtain sizes from the Engineer before proceeding with the work.

3.4 Mechanical Testing and Certification

3.4.1 After start-up and prior to final acceptance, the Contractor shall conduct Engineer-witnessed performance tests on the equipment.

3.4.2 The field service representative will cause the chemical piping and valve system to perform all mechanical functions that it has been designed to perform. Tests will be scheduled with the Engineer at least two (2) weeks prior to the planned test date.

3.4.3 The field service representative shall submit to the Engineer a written report stating that the equipment has been checked and is suitable for operation.

3.5 Leakage Testing

3.5.1 Pressure test complete installation of all piping to a minimum of 80 psi for a two (2) hour period following installation. Testing shall be completed on both the primary (carrier) and secondary (containment) piping. If any leaks are present, Contractor shall repair leaks and retest piping until no leaks are present.

3.6 Supervision of Installation and Commissioning

3.6.1 Test and commission the equipment in accordance with Section 01810 – Testing and Commissioning.

3.6.2 At the completion of satisfactory installation, each unit shall be started by the General Contractor under the supervision of the Supplier and with cooperation of the plant operating staff. All controls and alarms shall be checked and tested to ensure proper control and equipment protection.

3.6.3 Equipment installation shall only be accepted after receipt of a satisfactory report submitted by the Manufacturer's representatives.

3.6.4 Modify or replace equipment or materials failing required tests.

3.6.5 Perform additional testing required due to changes of materials and/or failure of materials or construction to meet specifications at no extra cost to the Owner.

3.7 Storage

3.7.1 Prior to the installation the piping, valves, fittings and accessories shall be protected and stored indoors in a dry area, in accordance with the Manufacturer's recommendations.

3.8 Maintenance

3.8.1 Provide maintenance on Supplier's equipment as required by the Supplier from the date of delivery to the initial start-up.

END OF SECTION

Item	Equipment Tag	Description	Valve Type (1)	Size (mm)	Service (2)	Specification Sections	Actuator Type (3)	SCADA Monitored?
1	V0900	NaClO Storage Tank Inlet Valve	BLV	50	ISV	2.3	HW	No
2	V0901	NaClO Storage Tank Outlet Valve	BLV	20	ISV	2.3	HW	No
3	V0902	NaClO Metering Pump 1 Inlet Valve	BLV	20	ISV	2.3	HW	No
4	V0907	NaClO Metering Pump 1 Discharge Valve	BLV	20	ISV	2.3	HW	No
5	V0903	NaClO Metering Pump 2 Inlet Valve	BLV	20	ISV	2.3	HW	No
6	V0908	NaClO Metering Pump 2 Discharge Valve	BLV	20	ISV	2.3	HW	No
7	V0909	NaClO Common Discharge Valve	BLV	20	ISV	2.3	HW	No
8	PRV0901	NaClO Metering Pump 1 Discharge Relief Valve	PRV	20	RV	2.6	-	No
9	PRV0902	NaClO Metering Pump 1 Discharge Relief Valve	PRV	20	RV	2.6	-	No

Notes:

1) Valve type:

ARV	Air Release Valve
CV	Check Valve
BFV	Butterfly Valve
PRV	Pressure Relief Valve
BLV	Ball Valve

2) Service:

ISV	Isolation Valve
CV	Check Valve
MOV	Motorized Valve
RV	Relief Valve

3) Actuator: **Related Section 11290 for Electric**

HW	Hand Wheel Actuator
SE	Standard Electric Actuator
ME	Modulating Electric Actuator

DIVISION 13 – CONTROL & INSTRUMENTATION

Section No.	Title
13100	Control & Instrumentation
13560	Instrumentation General Requirements
13560S1	Instrumentation and I/O List
13562	pH Analyzer
13563	Pressure and Level Instruments
13564	Miscellaneous Instrumentation and Accessories
13565	Temperature and Turbidity Instruments
13566	Magnetic Flow Meters
13567	Chlorine Residual Analyzer
13590	Network Cabling Equipment

1 GENERAL

1.1 Intent

1.1.1 It is the intent of this section to provide instrumentation and control systems for the new Blind River Low Lift Pumping Station that:

.1 Monitor and control process parameters and equipment to be supplied and installed under this contract, as shown on the drawings or specified.

.2 Are integrated into the new Programmable Logic Controller (PLC) system.

.3 Is monitored and controlled remotely by the existing Blind River Water Treatment Plant SCADA system.

1.1.2 The intent of this section is to provide instrumentation and control system works for the new Blind River Low Lift Pumping Station and integration with the existing Blind River Water Treatment Plant WTP.

1.1.3 Provide complete and fully functional instrumentation and control systems to suit the process design requirements as indicated on the Process and Instrumentation Drawings.

1.1.4 Provide a new telephone service line, including all equipment required by the local telecommunications service provider. The Contractor shall coordinate directly with the local service provider to confirm the demarcation point, installation requirements, and all equipment to be furnished by both the service provider and the Contractor. The Contractor shall not perform any trenching of duct banks or installation of buried conduits related to the new telephone service line shown on the Contract Drawings until coordination with the local service provider has been completed. Any modifications to routing or installation requirements resulting from this coordination shall be completed by the Contractor at no additional cost to the Owner.

1.1.5 Provide communications systems and hardware and software to suit the integration of all new automation systems into the new Blind River Low Lift Pumping Station SCADA network as well as communications retrofits to the existing Blind River Water Treatment Plant SCADA network.

1.1.6 Provide All Ethernet communications equipment and network switches. The contractor shall coordinate with the owner to identify an existing network cabinet suitable for installing a new fiber patch panel and network switch at the Blind River Water Treatment Plant as indicated on the Contract Drawings.

1.1.7 Provide All Telephone, Ethernet and Fiber communications equipment and cabling as indicated on the Contract Drawings.

1.1.8 The PLC programming of all packaged equipment is to be provided by the respective packaged equipment vendors. Coordinate with the Engineer for I/O mapping, communication, etc. Provide an I/O list and addresses for each PLC panel.

1.1.9 The custom process automation PLC programming of non-packaged PLC control panels is to be provided by the Engineer.

1.2 Description

1.2.1 The work consists of the supply and installation of all instrumentation, controls, SCADA system automation components specified herein and shown on the drawings, and commissioning by the Contractor to suit the new Blind River Low Lift Pumping Station.

1.2.2 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. The word “provide” shall be defined to mean supply, install, start up, test and commission.

1.2.3 This specification is intended as a functional description of the systems required and shall serve as a guide to the approved controls system supplier in providing the complete system. The Contractor will be required to submit supplier designed complete control wiring and communications shop drawings, in addition to shop drawings of equipment. The contractor is responsible for the design of the design of all the new control panels. The control panel layouts and dimensions identified on the drawings are based on minimum requirements. Provide additional control panel sections as required to suit the design of the respective control panel applications. The contractor will be responsible for coordination of shipping splits to ensure that multiple panel arrangements may be installed in respective areas of the pumping station facility based on available access.

1.2.4 The custom PLC automation for the PLC hardware supplied under this section to suit the Blind River Low Lift Pumping Station process system shall be developed and implemented by the Engineer.

1.2.5 The following new Control Panels will be provided by the Contractor:

.1 ICP - 0001 - Blind River LLPS Instrumentation Control Panel

1.2.6 Integration of the following new automation systems into the Blind River Water Treatment Plant SCADA system network will be provided by the Engineer:

.1 ICP – 0001 - Blind River LLPS Instrumentation Control panel

1.2.7 Contractor to provide the following new Communication Control Panels:

.1 IT-0001 – Blind River LLPS Main Communication Control Panel

1.2.8 Integration of the new non-vendor supplied automation systems into the new Blind River Low Lift Pumping Station SCADA system network will be provided by the Engineer.

1.2.9 Integrate any HVAC system OEM embedded automation systems into the SCADA system in accordance with the design drawings. Coordinate with Division 15.

1.2.10 Integration of the SCADA HMI system into the SCADA system in accordance with the design drawings will be provided by the Engineer. Contractor to supply and install new stainless steel lamacoids on all new equipment and instrumentation as shown on the contract P&ID drawings.

1.2.11 Contractor to provide new field wiring, power wiring, and conduits to all instruments and equipment unless otherwise noted. Refer to the Electrical and Instrumentation drawings.

1.3 General Requirements

1.3.1 Supply and installation of instrumentation, analysis provided under Division 11 – Equipment, Division 13 – Instrumentation, Control and SCADA, and Division 15 – Mechanical.

1.3.2 Supply and Installation of power, control, and communications wire interconnecting the control panels, and electrical and electronic pieces of the instrumentation equipment, under Division 16. Final wiring shall be as required by the reviewed shop drawings, (See Division 16 – Electrical).

1.3.3 Hydraulic and pneumatic control tubing, piping and appurtenances, interconnecting various pieces of the instrumentation equipment under Division 11 Equipment, Division 13 – Instrumentation, Control and SCADA, and Division 15 – Mechanical.

1.3.4 At all times, ensure that work being carried out by the Engineer or the plant operations staff is properly coordinated with all ongoing construction activities and are unhampered by unnecessary delays or obstructions.

1.3.5 All functionality described in the Tender Documents and Process Control Narrative shall be fully implemented.

1.3.6 All control wiring shall be continuous and without splices. All control wiring is required to transition through or terminate to DIN rail mounted terminal blocks. No marette connections of control wiring are permitted.

1.3.7 Data tables and instrumentation lists included in included in Division 13 – Instrumentation, Control and SCADA only identify electric instruments. The contractor is required to provide all instrumentation identified on the drawings, including all mechanical instruments and gauges.

1.3.8 Development of the custom graphical user interface application for the purpose of control and monitoring of the pumping station is to be performed by the Engineer. The Contractor is required to provide a test PLC programming to suit the verification of the complete controls and instrumentation installation to suit the PLC automation hardware, I/O, and communication links provided as part of this project. Test programming shall demonstrate that all new PLCs are capable of monitoring all inputs and control all outputs. Test programming is also required to demonstrate the functionality of all communication links identified on the SCADA architecture drawings.

1.3.9 Demonstrate operational equipment and put all equipment into operational service to the satisfaction of the Engineer.

1.3.10 All equipment performance requirements shall be based upon worst case scenarios and/or to the maximum capabilities of the equipment.

1.3.11 Provide documentation in a timely manner and as specified.

1.3.12 The Contractor shall prevent the following from occurring:

.1 The use and/or implementation of problematic, unstable hardware that is a result of device driver conflicts, component substitutes that deviate from specifications or fail to meet performance criteria, including unauthorized tampering with computer operating system or application setup parameters, all of which create additional setup time.

.2 Deficient factory acceptance testing due to non-compliance in panel assembly, substandard workmanship or poor preparation prompting the Engineer to reject FAT and thereby having to reschedule further sessions.

.3 Scheduling of Commissioning & Site Inspection, prior to the completion of all site works including, loop checks, instrument calibration, wire or installation, resulting in delays and repeat site visits.

.4 Lack of maintenance works to suit field equipment/devices including instruments, control hardware, motor starters, valve actuators, and all essential process systems required for the facility to run in a safe and fully automated fashion.

1.3.13 The Contractor shall supply a communications & automation equipment schedule for review prior to submission of all shop drawings. The schedule shall be tabular in form and have a minimum of:

.1 Item number and system description

.2 Tag number as specified herein or as shown on the drawings and Process and Instrumentation diagrams.

.3 Reference the specification section/subsection, item number, drawing number, P&ID tag, P&ID drawing number and description

.4 Proposed submission date.

.5 List of associated equipment. Note all equipment forming part of a system should be submitted at same time.

.6 List of all software as required to set-up/program field devices, including verification that all software is licensed in the name of the owner.

1.4 Related Divisions and Sections

1.4.1 Division 11

1.4.2 Division 13

1.4.3 Division 15

1.4.4 Division 16

1.4.5 Section 13560 – Instrumentation General Requirements

1.4.6 Section 13590 – Network Cabling and Equipment

1.4.7 Section 16010 – Electrical General Requirements

1.4.8 Section 16231 – Diesel Engine Driven Generator Unit

1.5 Standards

1.5.1 Equipment furnished under this section shall be designed, constructed, and tested in accordance with the latest edition and requirements of the followings:

.1 Canadian Standards Association (CSA)

.2 Canadian Electrical Manufacturers Association (CEMA)

.3 National Electrical Manufacturers Association (NEMA), and NEMA ICS-1-109.60

.4 The Instrumentation, Systems, and Automation Society (ISA)

.5 FCC Part 15 – Class A / Canadian's Interference-Causing Equipment Standards (ICESs)

.6 Institute of Electrical and Electronics Engineers IEEE-519

.7 ANSI C37.90

1.6 Quality Assurance

1.6.1 The materials, design, and workmanship employed in the manufacture of all equipment shall conform to the applicable standards established by the A.S.T.M. (American Society for Testing Materials), A.S.A. (American Standards Association), C.E.C. (Canadian Electrical Code) including the Ontario Supplement, C.G.S.B. (Canadian Government Specifications Board), C.S.A. (Canadian Standards Association), and the I.S.A. (The Instrumentation, Systems, and Automation Society). Canadian Standards shall take precedence over American Standards in the case of duplication or conflict.

1.7 Submittals

1.7.1 Conform with requirements of Division 1, including Sections 01330 – Submittal Procedures and 01770 – Closeout Procedures.

1.7.2 Conform with Section 13560 – Instrumentation General Requirements.

1.7.3 Provide a new SCADA communications architecture schematic to reflect the new SCADA system.

1.7.4 Provide a check list with each shop drawing submission. The check list is to indicate the following:

.1 Provide an instrument sheet to suit the submission of all instrumentation. Complete the relevant data field's specific to the type of instrument being submitted for review.

1.7.5 Provide specification data tables for each product. Data table is to be based on the product type that is to be submitted for review. Complete and submit the corresponding specification data table to suit each respective product as indicated in Division 13. Provide the instrument data submission. Each instrument shop drawing submission must be accompanied with a completed Instrument Submission Form. Completed instrument form is to be typed (hand written form is not acceptable).

1.7.6 Provide a completed form to suit all submissions by the contractor.

1.7.7 A detailed submittal package shall be furnished identifying the equipment to be supplied and its operation. The intent of the submittal is to ensure complete project scope coverage and does not relieve the supplier from fulfilling all specified requirements. The submittal shall consist of legible printed text and high quality CAD drawings bound in three-ring notebooks with index tabs that identify major sections of the document. The submittal shall address all hardware and software to be supplied. In addition:

.1 Identification of the respective responsibilities of each party to the project. Include what is provided by the system manufacturer, what is to be subcontracted, etc.

.2 SCADA/PLC Communications Architecture shop drawing detailing all communications links to suit the design drawing requirements. Architecture drawings shall identify all automation and communications networks including all components and media associated with each type of communications networks. Identify all component model numbers and media types. Identify all unique addressing for each device that communicates on the respective networks

.3 Description of the major user related features and operating characteristics of the proposed system.

.4 Description of all site PLC Automation hardware and I/O modules.

.5 All significant equipment to be supplied shall be listed followed by descriptive data sheets. The equipment list shall include each component name, manufacturer, model number, a description of the operation, quantity supplied and all special set-up and operation and maintenance characteristics.

.6 In addition to data sheets, all shop drawings are to be provided in digital (PDF) format.

.7 Provide electronic copies of the original AutoCAD control panel shop drawings at the request of the Engineer.

1.7.8 Drawing Index: Prepare a clear, typed index listing the number and title of all proposed purpose-made drawings and submit for review within 20 days after award of contract.

1.7.9 Milestone Schedule: Prepare and submit a proposed schedule of instrumentation and control work per General Conditions, indicating the following major milestones as a minimum:

.1 Hardware shop drawings submission – including initial issue of Product Date Sheets;

.2 Preliminary issue of operating and maintenance instruction manual;

.3 Panel inspection and factory acceptance testing (FAT);

.4 PLC and HMI test programming applications to suit FAT and SAT;

.5 Completed and signed calibration Form for each field instrument, in accordance with Section 13560 - Instrumentation General Requirements;

.6 Completed and signed Instrumentation Installation Checklist Form for each field instrument in accordance with Section 13560 - Instrumentation General Requirements;

.7 Report on proper site installation, inspection, and loop check;

.8 Final submission and sign-off of Product Date Sheets as per this Section and Section 13560 - Instrumentation General Requirements;

.9 Communications Panel SAT. This should include the Owner and the Engineer.

.10 Submission of I/O checks completed by the Contractor prior to the SAT. This shall be reviewed and verified prior to any SAT

.11 Site acceptance testing (SAT);

.12 Maintenance training sessions on filed instruments.

1.7.10 Communications Architecture Drawings

.1 Provide application specific communications architecture drawings to suit each type of communications networks/Protocol identified on the design drawings.

.2 Provide communications architecture drawings that are dedicated to each protocol type.

.3 Communications architecture drawings are required to include point to point details to suit each communications link.

.4 Provide communication cable tagging. Provide table that summarizes all communications cable tags.

.5 Coordinate with other vendors to include information such as equipment tied to the network along with ports, cable tags, and cable colour.

.6 Communications architecture drawings shall include the following information:

.1 Communications media type

.2 Termination details for each communications link and/or application

.3 Identify the length of each communication media link

.4 Device name and tag to suite each communication application

.5 Port Numbers as required to suit the application

.6 PLC Communications modules

.7 Network Switches

.8 MCC communications components

.9 Application specific connectors

.10 Copper Media Equipment, connectors, terminations

.11 Fiber Media Equipment, connectors, terminations

.12 Bill of material to suit all devices shown on the respective drawing

1.7.11 Application Specific Drawings:

.1 Prepare application specific drawings neatly and accurately by means of the latest version of CAD or as otherwise advised. Do not use external references or customized file extensions. Provide fully portable electronic file copies of all drawings.

.2 Make submission on reproducible material such as mylar, vellum or legal-size paper, complete with a title block containing the Project Contract number, your contract number and company logo, a drawing and Contract title as stated in the Contract drawings, and a referenced drawing number (related to a file name if applicable). Provide tabular columns to record the original submission date, a revision number, date and reason for subsequent revisions, and signature of authorized issuing staff member.

.3 Submit, as a minimum, the following application specific drawings:

.1 Scaled, reference, front of panel layouts, and general arrangements drawings;

.2 Scaled, referenced, internal panel layouts (may be combined with the above);

.3 Equipment or panel block wiring diagrams showing termination identification at each item of equipment, inter-wiring and cable numbering, all peripheral equipment, all PLC module DIP switch settings, pin assignments for D-shell connectors, plugs and jacks, and instrument/equipment tag numbers;

.4 Where issued, loop drawings are typical for guidance only. Submit itemized instrument wiring drawings for all analog process loops and discrete connections, generally in accordance with ISA S5.4 format and as a minimum incorporating the following details: PLC terminal numbers, PLC I/O Address, PLC Slot & Rack identification, Control Cabinet terminal numbers, field terminal numbers, wire numbers, contact orientation, power source identifications and equipment numbers. The AutoCAD files for these drawings are to be edited with “Record Drawing” detail and made accessible to the Engineer during the Contract. Include wiring by others that form part of the system or circuit.

.5 List of expendable materials and quantities;

.6 List of Instrument, Equipment and Panel Identification Nameplates, including all panel mounted component name plates.

.7 Factory test results.

.8 Project name and job numbers.

.9 Cable and wire requirements inclusive of specifications.

.10 Input and output signal ranges and calibrated ranges.

.11 Installation details including: material list, dimensions, process and electrical connection sizes and external wiring requirements.

1.7.12 Vendor Equipment Shop Drawings:

.1 Submit Shop Drawings for all field and panel mounted instruments, controllers, gauges and similar products. Manufacturer documentation will be accepted only if the following information is clearly indicated and highlighted for the equipment proposed. Submit the following:

.1 An itemized listing of proposed instrument or equipment, including tag numbers, quantities, options being provided and a full description and performance data;

.2 Installation details depicting mounting assemblies, physical dimensions, process connection size (e.g. flange ratings & styles);

.3 Termination details clearly indicating the type and lengths of external wiring required and electrical connections;

.4 Power supply rating input and output signal ranges, maximum measured process range and calibrated scale, physical, electrical and environmental requirements;

.5 Exact catalogue model numbers of each piece of equipment and its accessory options, and clearly referenced by the respective instrument or equipment tag name given in this document (improperly tagged items shall be rejected);

.6 A separate sheet with manufacturer's recommended list of spare parts including individual pricing with the shop drawings;

.7 A complete I/O list and loop drawings.

1.7.13 The Contractor shall note compliance and variance in writing or the specification shall have precedence over approved vendor drawings. Stamp the shop drawings submitted as either "COMPLIES WITH SPECIFICATION" or 'DEVIATES FROM SPECIFICATION" as appropriate. In the latter case, describe deviations exactly and indicate how they impact the specified duty of the component. The Engineer will assess acceptability of submission.

1.7.14 Product Data Sheets:

.1 Provide Product Data Sheets for all instruments and equipment to suit shop drawing submissions in accordance with Section 13560 - Instrumentation General Requirements and as specified herein. Product data sheets to include the information noted below and all other data pertinent to the equipment and the application.

1.7.15 Initial submission for review to accompany Shop Drawings:

.1 The product manufacturer and the supplier or representative;

.2 The complete model or catalogue numbers including all special options;

.3 The available adjustment ranges and the operating ranges.

.4 Supporting product documentation as indicated in Section 13560 - Instrumentation General Requirements and specified herein.

.5 Provide instrument data submissions.

1.7.16 Second submission during pre-commissioning, testing and calibration period:

.1 Serial numbers, part numbers, dates of installation and calibration;

.2 All special procedures required to duplicate calibration;

.3 This submission is for signature by the Contractor and the Engineer following acceptance of the operation of each instrument.

.4 The second submission shall include completed and signed Instrumentation Installation Checklist forms and Instrumentation

1.7.17 Final Submission of signed-off Product Data Sheets included with Operating and Maintenance Instruction Manuals:

.1 All of the above information; and

.2 Phone and fax numbers of contact person for product support/service.

1.7.18 Where there is any discrepancy, the description provided on the Product Data Sheet takes precedence over the model number given in the data sheet.

1.7.19 Record Copies of Purpose-made Drawings & Electronic Files:

.1 Submit six white print “as-built” copies of each Purpose-made drawing and document specified above, as well as electronic copies (on CD or comparable media). Under certain circumstances during the course of the contract, instead of paper, drawing and document files may be exchanged with the Engineer to streamline coordination.

1.7.20 Submission Format:

.1 A complete set of Purpose-made Drawings, Shop Drawings, and the initial submission of the Product Data Sheets shall be bound into one volume and issued for approval before the commencement of work.’

.2 Comply with the instrumentation submission requirements identified in Section 13560 - Instrumentation General Requirements.

.3 The Contractor shall prepare a product description sheet for each item or package submitted for shop drawing approval.

.4 Each shop drawing submission by the Contractor must be accompanied by a submission overview sheet that lists the individual items described in the respective individual product description sheets.

.5 Provide all communications architecture drawings on 11”x17” sheets.

.6 The product description sheet shall conform with submission requirements identified in Section 13560 - Instrumentation General Requirements and shall include the following information as a minimum:

.1 Submission date: Project:

.2 Submission #: Prepared by:

.3 Quantity: Instrumentation P&ID Tag:

.4 Manufacturer: Model No.:

.5 Description: Contractor ID No.:

.6 P&ID Drawing Number (i.e. Instrument Contract Drawing Reference):

.7 Each shop drawing submission shall include a shop drawing overview submission sheet that identifies information related to the project. The shop drawing overview submission sheet shall include the following information:

.1 Date of submission:

.2 Project:

.3 Prepared by:

.4 Submission Number: (i.e identify if it is first submission or resubmission)

.8 Equipment P&ID Tags: (summarize all P&ID Tags for equipment submitted for review)

.9 Provide the instrument data submissions.

.10 Any deviation from the above noted submission requirements and Section 13560 - Instrumentation General Requirements will result in the rejection of the submission.

1.8 Operations and Maintenance Manuals

1.8.1 Provide Operations and Maintenance (O&M) Manuals in accordance with Section 01770 – Closeout Procedures.

1.8.2 O&M manuals are to include documentation and information.

1.8.3 The following printed materials shall be provided a minimum:

.1 Detailed (O&M) manuals shall be provided with complete information concerning the operation of the system and support necessary with diagnostics.

.2 Data sheets shall be supplied for all equipment used in the system. The data shall include, as a minimum, the component name; manufacturer; model number, quantity and all special (O&M) characteristics.

.3 Final as-built drawings of equipment shall be provided and as a minimum include:

.1 Overall dimensions details for each equipment and all door mounted operator devices including nameplate designations.

.2 Interconnecting wiring diagrams of all control equipment, and communications networks.

1.9 Work Included

1.9.1 The Contractor shall be responsible for the:

.1 Supply, installation and commissioning of all Controls & Instrumentation equipment and devices specified herein and/or shown on drawings.

.2 Preparation of all descriptive data, schematic layout, interconnecting wiring diagrams, and communications architectures for submission and review as herein specified and in accordance with the requirements of the contract.

.3 Supply and install new PLC Control Panel, including the panel mounted HMIs. The engineer is responsible for integration of the SCADA system.

.1 ICP - 0001

.4 Supply and install IT panel IT-0001 located at Blind River Low Lift Pumping Station. The engineer is responsible for integrating and configuring the IT Panel.

.5 Supply, install, and integrate a new Auto-Dialer located at the new Blind River Low Lift Pumping Station. The integrator is responsible for integrating and configuring the alarms.

.6 Provide alarm dialing functionality based on the use of a VoIP server. VoIP setup, compatibility, and operation is to be tested and verified prior to deployment of the SCADA system servers. The SCADA alarm dialer requires the configuration of an SMTP email server to allow for emailing of critical process alarms. The engineer is responsible for integrating and configuring all email alarms.

.7 Provide a new SCADA communications architecture schematic to reflect the new SCADA system.

.8 The Contractor is required to conform to all equipment manufactures shop drawings documentation to suit the equipment installation requirements.

.9 Supply and installation of new PLC and communications modules specified herein and to suit contract drawing requirements.

.10 Provide all networks hardware, wiring, UPS and Ethernet switches.

.11 The installation, wiring and point to point checkout of all communications cabling including;

.1 CAT6 Ethernet

.2 Fiber optic

.3 RS-485/Modbus serial cable

.12 Supply and installation of new PLC and I/O modules specified herein and to suit contract drawing requirements + 20 percent spare capacity for each type of I/O.

.13 Provide network media certification documents prior to deployment of any server or communication hardware in the field. The contractor is required to provide copies of the network media test reports to the Engineer prior to the SAT.

.14 The Contractor shall provide a test program for the new automation hardware to demonstrate the functionality of all the physical I/O, virtual I/O, located in the respective automation hardware and available via communications networks. The individual test programs shall demonstrate that the new PLC and automation hardware located in the new PLC panel specified in this section are able to monitor and control all local I/O. The Contractor must demonstrate that all PLC control panels are able to read/write/control all communications based I/O.

.15 The Contractor shall provide a certification for each communication cabling type after installation and testing.

.16 Installation of wiring and wiring terminations to suit connection of field devices as shown on contract drawings. Refer to electrical drawings for location of field instruments & equipment and Section 01120 – Coordination & Sequence of Work for sequence of construction.

.17 Testing, calibration, and commissioning of each signal loop.

.18 Supply and installation of all Terminal Blocks, control wiring, and auxiliary relays as shown on the drawings.

.19 The installation, wiring and point by point checkout of proposed field devices and instrumentation.

.20 Supervision, calibration and communications systems checkout for remote control systems in the field to the Engineer's satisfaction. The Contractor will be responsible for complete communications and automation system verification, and submit to the Engineer in writing (typed) verification and results of said communications and automation checkout, including details of automation testing and communications settings of equipment, prior to commissioning.

.21 Provide complete record drawings. Drawings to be produced using latest version of AutoCAD program and supplied to the customer on CD ROM. Also provide one print set of reproducible record drawings (size A1). The Contractor shall also be responsible for providing detailed wiring diagrams, and equipment manual, upon satisfactory commissioning and certification of work.

.22 The installation, wiring and point by point checkout of proposed communications networks.

.23 The installation and wiring of all control and instrumentation equipment supplied under this contract.

.24 Division 16 to provide power to all electrical equipment whether equipment supplied by this Division or by others, or pre-selected. Provide local disconnect switches (fused or un-fused) as required by code whether shown or not. Coordinate this equipment supply and wiring with the Electrical Contractor.

.25 Commissioning of all equipment to be by the manufacturer's representative.

.26 Installation of wiring and wiring terminations to suit connection of field devices as shown on contract drawings.

.27 Testing and commissioning of communications networks including verification of communications from the PLC to all devices located on the respective remote networks.

.28 Supply and installation of all Terminal Blocks, control wiring, and auxiliary relays as shown on the drawings.

.29 The Engineer is responsible for the following scope of work:

.1 To integrate the new Blind River LLPS SCADA system.

.2 To integrate, test, and commission the new Blind River LLPS SCADA system into the existing main SCADA HMI system located at the Blind River Water Treatment Plant. Verify that the new SCADA system is integrated into the existing Blind River Water Treatment Plant SCADA system.

.3 To integrate, test, and commission the new Blind River LLPS SCADA alarms into the existing Allen Bradley RSView 15.3 alarm system located at the Blind River Water Treatment Plant. The integrator is responsible for integrating and configuring the alarms. Alarms to be determined by the Engineer during the SCADA meetings. Contractor to provide a request for alarm list during integration. Assume all virtual and real alarms are to be integrated into the existing alarming system.

.4 To integrate all communication equipment including but not limited to PLC, cameras, etc.

1.9.2 Detailed control loop wiring drawings for the proposed hardware in AutoCAD latest version as per contract drawings.

1.10 Standards

1.10.1 Comply with the requirements of the latest edition of the applicable CSA Standards, the requirements of the Authorities, Federal, Provincial and Municipal Codes, the applicable standards of the Underwriter's Association and all other authorities having jurisdiction. These codes and regulations constitute an integral part of these Specifications. In case of conflict, the codes take precedence over the Contract Drawings.

1.11 Coordination

1.11.1 It will be the responsibility of the Contractor to coordinate work to be wired under this division.

1.11.2 The Contractor will coordinate work with other Divisions where there is an impact or overlap of work with this Division.

1.11.3 Ensure that other Divisions provide all necessary material and work required by this Division for the installation of equipment and wire, which falls under the responsibility of this division.

1.11.4 Conform with Division 1 – General.

1.12 Control System Supplier

1.12.1 The acceptable Control System Supplier (CSS) shall install complete controls, instrumentation, SCADA System Computer hardware, SCADA system software, PLC programming software, reporting software, alarm software, PLC automation, remote I/O modules, communications system. The acceptable CSS for Division 13 shall be one of the following:

.1 Brock Solutions Inc.

.2 Procon Consructors Inc.

.3 Quantech Electrical Contractors Limited

.4 Actemium Canada

.5 Approved Equivalent.

1.12.2 Equipment and software furnished under this section and under other related sections shall be designed with the exception of the vendor provided equipment, coordinated, and supplied by a single manufacturer or supplier, hereinafter referred to as the Control System Supplier. The Control System Supplier shall be regularly engaged in the business of supplying computer-based monitoring, control, and data acquisition systems. The Contractor shall utilize the services of the Control System Supplier to coordinate all control system related items, to check-out and calibrate instruments, and to perform all testing, training, and startup activities specified to be provided

1.12.3 The acceptable control system supplier shall provide proof being CSA certified to suit the custom fabrication of the control panels specified herein and show on the drawings when requested by the engineer. The facility must be wholly owned by the control system supplier and may not be a subsidiary company or sub-contractor. The occupancy of the CSA certified fabrication facility is to be an industrial/commercial type as defined under the OBC. No facilities located in a residential occupancy will be acceptable.

1.12.4 The control system supplier shall identify the specific staff members, including system engineers, maintenance engineers, PLC programmers that will be responsible for the control system works specified herein.

1.12.5 The proposed control system supplier must demonstrate that the company has successfully completed control system supply projects to suit a minimum of three Municipal Water/Wastewater Treatment Plants construction projects for which they supplied PLC automation and instrumentation to suit the complete treatment process. Two of the 3 facilities must be new green field projects, only one of the projects may be a process retrofit to an existing facility. Provide documentation identifying the project specifics including, Owner, Operator, Design Engineer, General Contractor, and the name of a project manager representing the owner.

1.12.6 Systems supplied under this section shall be designed and coordinated by control system supplier for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications, under other contracts, and, where applicable, with related existing equipment.

1.12.7 The Control system supplier shall be responsible for coordinating with the equipment vendors under other sections of these specifications and under other contracts to install the vendor supplied loose instruments and devices that require field installation. The control system supplier shall provide all the necessary mounting hardware, piping, wiring, and etc. for proper operation of the vendor supplied field instruments and devices.

1.12.8 All equipment shall be designed and installed in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the manufacturer, and the manufacturer of the related equipment.

1.12.9 Related Equipment and Materials. Related equipment and materials may include, but will not be limited to, instrumentation, motor controllers, valve actuators, chemical feeders, analytical measuring devices, conduit, cable, and piping as described in other sections or furnished under other contracts.

1.12.10 The drawings and specifications indicate the extent and general arrangement of the systems. If all departures from the drawings or specifications are deemed necessary by Control System Supplier, details of such departures and the reasons shall be submitted to Engineer for review with or before the first stage submittal. No departures shall be made without prior written acceptance.

1.12.11 The specifications describe the minimum requirements for hardware and software. Where the Control System Supplier standard configuration includes additional items of equipment or software features not specifically described herein, such equipment or features shall be furnished as a part of the system and shall be warranted as specified herein.

1.12.12 Layout dimensions will vary between manufacturers and the layout area indicated on the drawings is based on typical values. Control System Supplier shall review the contract drawings, the manufacturer's layout drawings and installation requirements, and make all modifications requisite for proper installation subject to acceptance by Engineer. At least 1100mm of clear access space shall be provided in front of all components of the computer control system components.

1.12.13 Assist with start-up & commissioning of all PLC/SCADA controlled equipment such as PLC control panels, communication panels, HMI workstations, etc.

1.12.14 The Control System Supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure.

1.13 Control System Integrator/Programmer

1.13.1 The Integrator/Programmer provided by the Engineer shall provide the ICP PLC/HMI/SCADA programming All PLC/SCADA programming shall be inclusive of the following:

.1 Prepare detailed control narrative based on process narrative.

.2 Programming of all PLC’s SCADA Computers and local Ethernet Communications Network.

.3 Integration of auxiliary network systems that are installed and pre-configured by the Contractor.

.4 Development of graphical user interface applications to suit the SCADA Computers and related custom HMI SCADA application.

.5 Verification of all I/O on site.

.6 Assist with start-up & commissioning of all PLC/SCADA controlled equipment.

.7 Software FAT – Complete system automation

.8 HMI screenshots for the Engineer's review prior to the SAT

.9 SAT – Complete system automation

.10 PLC/SCADA Programming documentation

.11 PLC/SCADA Manual

.12 PLC/SCADA Training – on site

.13 Integration of the new Blind River LLPS SCADA system into the existing main SCADA system located at the Water Treatment Plant.

1.13.2 The Contractor shall provide the following

.1 Verification and demonstration of all I/O on site.

.2 Start-up and commissioning of all PLC/SCADA controlled equipment.

.3 Factory Acceptance Testing and Site Acceptance Testing of all control panels provided by the Vendor.

1.14 Job Conditions

1.14.1 Examine the site and contract documents in accordance with Instructions to Vendors.

1.14.2 Attend site visits during the tender period to verify the existing conditions to suit the required works shown on the drawings and specified herein.

1.15 Quality Assurance for Copper Cables

1.15.1 The materials, design, and workmanship employed in the manufacture of all equipment shall conform to the applicable standards for Copper cables.

1.15.2 The cable must meet the requirements of C (UL) CEC approved as communications cables meeting the requirements for the Bi-National Standard CSA C22.2 No. 214/UL 444 and Section 60 of the Canadian Electrical Code, Part 1 (CEC). The C (UL) cable designation (and its meaning) would be one of the following:

.1 CMP – Cable meeting CSA FT6 or UL 910

.2 CMR – Cable meeting UL 1666

.3 CMG – Cable meeting CSA FT4

.4 CM – Cable meeting UL 1581, Section 1160 (Vertical Tray)

.5 CMX – Cable meeting UP 1581, Section 1080 (VW-1)

.6 CMH – Cable meeting CSA FTI

1.16 Quality Assurance for Ethernet Cables

1.16.1 The materials, design and workmanship employed in the manufacture of all equipment shall conform to the applicable standards for Ethernet Cables, Category 6 type:

.1 ANSI/TIA/569-A-1-2000 – Surface Raceways

.2 ANSI/EIA/TIA-569-A-2-2000 – Furniture Pathways and Spaces

.3 ANSI/EIA/TIA-569-A-3-2000 – Access Floors

.4 ANSI/EIA/TIAAAA-569-A-4-2000 – Poke Thru Fittings

.5 ANSI/EIA/TIA/569-A-7-2001 – Cable Trays and Wire ways

2 PRODUCTS

2.1 General Requirements

2.1.1 Electrically heat traced sensing lines for instruments with sensing lines liable to freezing.

2.1.2 Unless otherwise shown or specified, provide instruments located in hazardous areas with Ontario Electrical Code ratings for class, group, and division as shown.

2.1.3 All line voltage powered instruments are to be suitable for a 120VAC power supply. All line voltage AC powered instrument not CSA certified must bear an ESA Special Approvals Branch label.

2.1.4 Normal instrument and control power supply for the Contract is 120VAC. Emergency power supply is from associated UPS. Provide all line powered instruments suitable for use on these supplies with appropriate CSA approval.

2.1.5 As applicable, instrument control output is to be from 4 to 20 mA, linear, isolated capable of driving a maximum load of 750 ohms, unless otherwise specified.

2.1.6 Provide all the necessary mounting hardware, electrical connections, transducer junction boxes, power supplies, and all accessory items or options required to satisfy each application.

2.1.7 Provide corrosion resistant stainless steel or epoxy coated screws, bolts, fasteners, etc. in all applications.

2.1.8 Provide all special instrumentation communication cables, transducer cables, power cables, process sensing/sampling lines and capillary tubing in field measured lengths without joins as required by manufacturer. Allow adequate cable/capillary etc. to allow removal of instrument/transducer from process. Agree instrument-mounting locations with Engineer to ensure accurate field measurements.

2.1.9 Provide mechanical protection for capillaries and transducer cables and adequately secure to eliminate sagging.

2.1.10 All instruments shall be provided with process isolation valves. Valves must be utilized on all instrument lines for easy removal without disruption to the process.

2.1.11 All readouts, indicators, recorders, etc., shall be in metric units, whether shown or not and in engineering scales. All final units, ranges, set points, colours, etc., will be finalized on the shop drawings.

2.1.12 The Contractor shall be responsible for supplying all required communications setup and/or wiring, etc., and all other appurtenances which may be required, in order for the entire control and instrumentation system to operate as intended by this specification and as designed. Unless specifically stated otherwise, all control and readout signals, etc., shall be linear.

2.1.13 For wiring, see Division 16 - Electrical.

2.1.14 Equipment specified includes automation hardware, communications hardware and control equipment (including panels/enclosures) as specified herein and shown on drawings.

2.1.15 Without limitation to the following sections of this item, the equipment supplied shall be complete with all accessory items, whether specifically mentioned or not, so as to provide completeness of installation, and operation as intended.

2.1.16 The equipment specified shall generally be an "all electronic" control system, with linear isolated outputs from all instruments, 4-20 mA DC unless otherwise noted, and suitable for 115 volts, 60Hz, single phase operation.

2.1.17 No instruments shall be included in the design which utilize mercury or all other highly toxic substances, which through error or otherwise may enter and endanger the water supply.

2.1.18 All instruments and control elements shall be fully pre-wired and pre-piped in the factory and shall be equipped complete with terminal, terminal blocks and taps suitable for direct connection in the field.

2.1.19 Mounting brackets, hooks, plates, screws, bolts, anchors, etc., shall be stainless steel or epoxy coated and of sufficient size to permanently mount the equipment.

2.1.20 All process controls and instrumentation shall be complete with all necessary appurtenances to perform the functions indicated on the control schematics and electrical drawings with respect to inputs, outputs, etc.

2.1.21 Equipment specified includes instrumentation (including appropriate mounting hardware) and control equipment (including panels/enclosures) as specified herein and shown on drawings. Primary devices, transmitters, receivers, signal protection, conditioning equipment, indicators, switches (pressure/flow/temp.) etc. is to be included.

2.1.22 The Control System Supplier shall be responsible for providing ventilation and/or dedicated cooling systems for all the control panels supplied by the Control System Supplier. Size the ventilation/cooling systems to provide sufficient air changes to dissipate excess heat generated by internal components. Maintain panel ambient temperature to suit the operating requirements of the internal components.

2.2 Service Conditions and Environmental Requirements

2.2.1 The equipment provided for the control system shall be suitable for the service conditions specified in the equipment sections.

2.2.2 All equipment shall be designed and selected to operate without degradation in performance throughout the environmental extremes specified. Equipment shall be designed to prevent the generation of electromagnetic and radio frequency interference and shall be in compliance with FCC Rules and Regulations, Part 15, for Class A computing devices.

2.2.3 All control system equipment located in air-conditioned rooms shall be suitable for operation in ambient temperatures from 10°C to 35°C and a relative humidity of 10 to 80%, noncondensing. All equipment located in non air-conditioned indoor areas shall be suitable for an ambient temperature range of 0°C to 50°C and a relative humidity of 10 to 95 percent, noncondensing. All equipment located outdoors shall be suitable for operation in an ambient temperature range -20°C to 60°C and a relative humidity of 5 to 100%. Heaters and air conditioning/cooling equipment shall be provided where essential to maintain equipment within its manufacturer-recommended operating ranges.

2.2.4 All control system equipment will be installed in areas without anti-static floor construction and without any provisions for control of particulates or corrosive gases.

2.2.5 All input/output hardware shall meet or exceed, without false operation, all requirements of NEMA ICS-1-109.60, Electrical Noise Tests.

2.2.6 The equivalent "A" weighted sound level for all system equipment located in the treatment plant control room, except printers, shall not exceed 35 dBA. The sound level for printers shall not exceed 65 dBA. Sound reduction enclosures shall be provided where necessary to comply with these limits.

2.3 PLC & Automation Equipment

2.3.1 Supply and install all equipment listed in the BOM of the contract drawings for the following communication panels:

.1 ICP-0001 – Blind River LLPS Instrument Control Panel

2.3.2 The contractor shall provide a PLC control panel to suit the integration of the new process system I/O and communications, including I/O required to suit future process applications. Instrumentation Control Panels shall include the following key components:

.1 Allen Bradley CompactLogix Hardware:

.1 Refer to the contract drawings for reference.

.2 Allen Bradley ControlLogix CPU complete with minimum 10 Mb of battery backed Static RAM Model 1769-L83E with Ethernet connection port.

.3 Secure Digital (SD) Nonvolatile Memory – 1784-SD2 (2GB memory card)

.4 Power Supply – 1756-PA75

.5 17 Slot Chassis: 1756-A17

.6 I/O Modules

.1 Discrete Input Module: 1756-IA16I

.2 Discrete Output Module: 1756-OA16I

.3 Analog Input Module: 1756-IF8IH

.4 Analog Output Module: 1756-OF8I

.5 Provide Removable Terminal Blocks (RTB's) for all I/O modules: 1756-TBCH and 1756-TBNH as required.

.6 One spare wiring arm for each I/O module supplied.

.7 All Inputs shall be optically isolated.

.8 All discrete Outputs shall transition through DIN rail mounted interposing relays complete with 10A, 120VAC dry contacts and LED operation indication.

.9 Analog transmitters located outside of the main building must transition through a 24VDC loop Isolator/surge suppressor. Isolator to be 24VDC DIN rail mounted, Pribusin or approved equivalent.

.10 Provide Rack layouts in accordance with the contract drawings.

.7 All Allen Bradley connection cables to suit the communications requirements identified on the SCADA architecture drawings including cables, connectors, for Ethernet communications networks.

2.3.3 Provide surge suppression lightning arrestor module for copper media communications links to the respective remote PLC/RTU/RIO.

2.3.4 Provide all communications cables to suit the Architecture on the contract drawings.

2.3.5 Provide all Optical Fibre, Modbus serial, and Ethernet cabling, Fibre and Ethernet jacks as required for a complete network suit Control Architecture drawings.

2.3.6 Supply and install quantity of I/O modules to suit I/O for all field devices and transmitters as shown on control drawings, plus 20% spare capacity for each type of I/O. 20% spare capacity to be calculated based on I/O requirements for field devices and instrumentation terminated as per this contract and including instrumentation to be terminated as part of future works.

2.3.7 I/O modules identified for future/spare capacity I/O on the control shop drawings shall all be brought to terminal blocks.

2.3.8 UPS – Backup & Maintenance ByPass

.1 Provide UPS VA rating in accordance with UPS section.

.2 UPS to be installed in each PLC control panel.

.3 Ensure that the UPS dimensions are compatible with the control panel installation. The UPS shall be of an orientation that does not impede access to any components or wiring in the control panel.

.4 Provide a maintenance Bypass module to suit the manual transfer of the connected critical control panel load from the ups supply to the normal utility power without interruption to the critical control panel load. Provide all mounting hardware and power cables to suit installation in the respective control panels.

.1 Acceptable Product:

.1 Liebert MicroPod.

.2 Approved Equivalent.

2.4 Hardware/Software

2.4.1 The contractor is responsible for providing the following hardware/software (2 weeks after the shop drawings have been approved) to the integrator, including licenses in the name of the Owner:

.1 SCADA Hardware, including industrial panel mount computers, PLC programming and HMI application software

.2 Windows based Factory Talk Version 12.00.00 software

.1 Provide Factory Talk Version 12.00.00 Software (Industrial HMI Panel Mount Computers located in ICP-0001) as indicated on the drawings. Software version to be confirmed with the Owner.

2.4.2 Existing Reporting software

.1 Retrofit the Blind River WTP SCADA Reporting system to integrate the new Blind River LLPS SCADA system.

2.4.3 Existing Alarming software

.1 Retrofit existing Factory Talk Alarm software located at the Water Treatment Plant and configure as required to integrate alarms from the new Blind River LLPS SCADA system.

.2 Provide a list of all alarms with description and tags for the Engineer's review. The alarm list shall include critical alarms and non-critical alarms for the existing Factory Talk alarming system.

2.4.4 Successful testing of the above equipment shall be confirmed in writing by the Contractor prior to shipping.

2.4.5 The Contractor shall retrieve the above equipment for installation in the field as directed by the Engineer at no additional cost

2.4.6 The Contractor shall be responsible and ensure all SCADA hardware and software equipment during transportation to and from the engineer's specified location, and for the

duration of the equipment is in the possession of the engineer. The Contractor shall pay for all transportation and insurance costs

2.5 HMI/OIT Industrial PC

2.5.1 Supply, configure, install, integrate one HMI Panel on the door of the Instrument Control Panel ICP-0001.

2.5.2 Panelview Plus 7

.1 Model: 2711P-T15C21D8S

.2 15-inch diagonal TFT Display c/w LED Backlighting, 1024 x 768 maximum resolution

.3 4:3 Aspect Ratio, Widescreen

.4 300 nit Brightness

.5 Resistive Touchscreen c/w serial and USB interface

.6 NEMA 12 Painted Stainless Steel Bezel Panel Mount

.7 Integrated Operator Panel

.8 External 24VDC Power Supply required

.9 Two Year Warranty

2.5.3 Provide Factory Talk based HMI applications for the Instrumentation Control Panel ICP-0001 in accordance with the SCADA application standards.

2.5.4 Contractor is to confirm the part number and model number for the HMI and software version with the Owner prior to purchase.

2.5.5 Contractor is to coordinate with the Owner before purchasing the SCADA HMI software and the license in the name of the Owner.

2.6 Communication Systems

2.6.1 All communications equipment and cabling for a fully functional system is to be supplied by the Contractor unless otherwise specified.

2.6.2 Supply and install all equipment listed in the BOM of the contract drawings for the following communication panels:

.1 IT-0001 – Blind River LLPS Communication Control Panel

2.6.3 Contractor is to note that the BOM in the contract drawing is for illustration purposes only and shall provide any additional equipment and no extra cost to achieve the intent of the design.

2.6.4 The Bill of Materials and details on the drawings and specifications are not comprehensive. It is the Contractor's responsibility to determine, supply and install all additional components,

hardware and materials necessary to fabricate a complete and functional system at no extra cost.

2.6.5 Provide the communications cabinet model and type specified herein and as shown on the design drawings.

2.6.6 Provide all hardware required to suit the installation of all components identified on the drawings, including custom brackets to suit the installation of the communication panels.

2.6.7 The contractor is required to supply and install networks switches and patch cables in the communications cabinet, as shown on the drawings and specified herein.

2.6.8 Provide shop drawings of the main networks cabinet detailing all the installation of all Contractor supplied.

2.6.9 General Requirements

.1 The unit shall be designed to provide a secure, managed environment for server and networking equipment.

.2 The unit shall conform to EIA-310 Standard for Cabinets, Racks, Panels and Associated Equipment and accommodate industry standard rack mount equipment.

.3 The unit shall be designed with four vertical posts to allow rack mount equipment installation utilizing four vertical mounting rails.

.4 The unit shall be available with a vertical equipment mounting space.

.5 The unit shall be available to order with one part number configured with all enclosure components pre-assembled.

2.6.10 Equipment Access and Mounting

.1 The unit shall provide adequate vertical mounting space.

.2 The vertical mounting rails shall be easily adjustable to allow different mounting depths.

.1 The vertical mounting rails shall have a second set of EIA mounting holes perpendicular to the primary mounting holes to allow devices to be mounted in the side channel.

.2 Each vertical mounting rail shall be marked on both sides with lines showing the top and bottom of each U and the number U space next to the middle hole. Each U consists of three square holes and is 44.45mm high.

.3 The unit shall include at least 60 sets of nuts, bolts and cup washers, and nut tool for the mounting of equipment inside the unit.

.4 Both the front and rear doors shall be designed with quick release hinges allowing for quick and easy detachment without the use of tools.

.1 The front and rear doors shall open a minimum of 130 degrees to allow easy access to the interior.

.2 The front door of the unit shall be reversible so that it opens from either side.

.3 Split rear doors are provided for increased service clearance.

.4 The front door of the unit shall be capable of being installed on the rear of the unit, and the rear doors shall be capable of being installed on the front of the unit.

.5 The unit shall include two-piece removable side panels that are removed without tools using easy finger latches for fast access to cabling and equipment.

.1 The side panels on the unit shall double as privacy panels when the units are bayed together.

2.6.11 Material Requirements

.1 All weight bearing components shall be constructed from steel with a thickness no less than 0.9mm (20 gauge).

.2 All metal parts shall be painted using a powder coat paint process.

.3 Plastic materials shall comply with Underwriters Laboratory Specification 94 with V-1 rating (UL94 V-1) or better.

2.6.12 Grounding Requirements

.1 All enclosure panels and rack-mounted equipment shall be inherently earthed or grounded directly to the frame.

2.6.13 Environmental Requirements

.1 The unit shall have a minimum of IP 20 rating for protection against touch, ingress of foreign bodies, and ingress of water.

2.6.14 Safety Requirements

.1 The enclosure shall both protect the user from mechanical hazards and generally meet the requirements for a mechanical enclosure (stability, mechanical strength, aperture sizes, etc.) as defined in IEC 60950 Third Edition.

2.6.15 Cable Management

.1 The unit shall have clearance for wiring access of at least 75mm between the inside surface of the front door and front mounting face of the vertical mounting rails.

.2 The unit shall have clearance for wiring access of at least 37mm between the side panel and the vertical mounting rails.

2.6.16 Packaging

.1 The unit shall ship on a wooden pallet. Optional packaging should be available for shipping racks with 1250lbs and 2000lbs of installed equipment.

.2 The unit shall be bolted to the wooden pallet for stability during shipment.

.3 The unit shall be protected by corrugated corners, which are stretch-wrapped to limit damage during handling.

.4 The unit shall have a “damage report” sticker on the outside of the packaging which instructs customers to call a toll-free customer support number to resolve possible shipping damage issues.

2.6.17 Delivery and Installation

.1 The unit shall be shipped fully assembled as one orderable SKU.

.2 The manufacturer shall offer an inside-delivery shipping option which includes reasonable delivery to the inside of a customer’s building and removal and disposal of shipping material and packaging.

2.6.18 Accessories

.1 Rack Power Distribution Units: The manufacturer shall provide single-phase and/or three-phase power outlet strips, as required to suit the application, with built-in surge protection, current monitoring and/or rack mounted data-line surge protection devices.

.2 Cable Management: The manufacturer shall provide cable management accessories to neatly organize the routing of data and power cables within the enclosure.

.3 Shelving: The manufacturer shall provide fixed and sliding shelves with the ability to support up to 250lbs of non-rack mount equipment, as required to suit the specific panel application.

.4 Stabilization: The manufacturer provides stabilizer plate kit to be used as an anti-tip device and bolt-down bracket kit for floor anchoring.

2.6.19 All Ethernet and fiber networks to be certified by one of the following 3rd parties that is different from the communication system supplier. These companies are certified Corning and Panduit structured cabling installers:

.1 APCI (http://www.apci.on.ca/)

.2 FiberCore (http://fibercore.on.ca/html.htm)

.3 PlanGroup(http://www.plan-group.com/what-we-do/services/structured-cabling/

.4 Selectra Controls (http://www.selectra.ca/master_home.htm)

2.6.20 All fiber optic cables to be 12-strands (color coded) singlemode. For details of installation and requirements of fiber network.

2.6.21 Contractor is to provide, install and test the network connection as shown on network drawings.

2.6.22 The unit shall provide adequate ventilation to provide airflow required by the major server manufacturers.

2.6.23 The unit shall include door locks and side panel locks that are keyed the same; two keys included. Vendor to coordinate with the Owner prior to providing any locks or keys.

2.6.24 Supply, deliver, install and test all network cabling including Ethernet CAT6 10/100 Base-T, optical fiber and all other network cabling required for a completely functional control system and network. All network components to be tested to TIA/EIA 568-A Category 6. Testing to conform to current TIA/ISO channel standards.

2.6.25 Install, test and commission power supplies, PLC modules, PLC racks and controllers with all required cables to provide a fully functional SCADA system network. Contractor is to provide a fully functional SCADA system network. Contractor is responsible for verifying the quantities and for all additional components and cables required to complete the work as defined in the specifications and on the drawings. Install as per the directions of the Consultant and the Contract Drawings.

2.6.26 All PLC/HMI development, testing and implementation; should be completed by the Engineer and approved by the Owner.

2.6.27 Supply, install, and commission of all hubs, switches, routers, transceivers, ethernet patch panels and all other communication equipment identified on the contract drawings unless otherwise noted. Fiber Patch Panel to have accommodation for all fibers connections. Supply, install and test all Fiber terminations. All dark fibres to be terminated in patch panel.

2.6.28 All Industrial communication networks must be validated and certified by reputable and experienced independent third party with a full written report and warranty.

2.6.29 Each communication cable is to be tested by a certified vendor and submitted in a shop drawing verify that the respective cable has passed.

2.6.30 Supply, install and certify all copper and interconnecting cables required for a fully functioning network. All patch and interconnection cables are to be factory made.

2.6.31 Fiber Optic Media Converter

1. Fiber optic media converter for Ethernet LANs for conversion between UTP 10BaseT or 100BaseTX or 1000BaseTX to full duplex fiber optic cable. Quantity to suit the drawings.

2. Fiber optic media converter for Ethernet LANs for conversion between UTP 10BaseT or 100BaseTX or 1000BaseTX to full duplex fiber optic cable. Quantity to suit the drawings.

3. Fiber optic port connectors shall be SC or ST type compatible with duplex fiber applications. Connector losses shall be less than 1-2dB/connector at 1300 or 850nm wave lengths.

4. Fiber converters shall be suitable for optical transmission at 1300 or 850nm wave lengths and shall have a minimum transmission range of 1000m.

5. Fiber converters shall be supplied with an external power supply to suit a 120VAC power feed.

6. Acceptable Product:

1. Allied Telesyn model AT-MC102XL10, provide quantity to suit architecture drawings plus one spare module for every two supplied.

2.6.32 Supply and install Hirschmann BRS30 Ethernet switches (BRS30-0404OOOO-SFCY99HHSES) with uplink ports and SFP transceivers for each Communication Control Panel as shown on the drawings. CAT6/Fiber patch cables to be run as per the network drawing.

2.6.33 SFP modules are not provided together with Ethernet switches and are to be supplied separately, as needed, determined by the design and compatibility with the fiber being installed:

.1 Singlemode SFP Part Number: Hirschmann, M-SFP-LX/LC EEC SFP Module.

2.7 Autodialer

2.7.1 The Contractor shall provide an Autodialer the new Blind River Low Lift Pumping Station. The Autodialer shall be connected to an analog Bell telephone line via a connection to the Bell analog analogue patch panel. The Autodialer shall be connected to the Process Control Network via an Ethernet patch to the Process Control patch panel

2.7.2 Contractor shall be responsible for configuration of the Autodialer to detect alarms from all ICPs at the new Blind River Low Lift Pumping Station. Contractor is to issue appropriate voice messages sent via a Bell telephone line to the Owner's plant personnel. Refer to drawings and I/O list for connection details

2.7.3 The Owner shall supply the Contractor with all phone numbers to be programmed into the system.

2.7.4 Operating voltage: 105-135 VAC, 15 W or 8-14 VDC, 500mA

2.7.5 Minimum 8 discrete alarm channels and 96 virtual channels.

2.7.6 Ethernet I/P compatible.

2.7.7 Wall mounted, complete with surge protection and indoor rated enclosure.

2.7.8 Contractor is to request an alarm list prior to the SAT from the Engineer for all hardwired and virtual.

2.7.9 Contractor to coordinate with the packaged system vendors to confirm specific alarms that require dial out.

2.7.10 Acceptable product: RACO Verbatim Gateway.

2.8 Software Documentation

2.8.1 CSS shall furnish complete documentation on all software supplied with the system specified herein. Operating systems, compilers, assemblers, and utility and diagnostic programs that are standard commercial products of third parties need not be included in the

magnetic/optical media backup. Software documentation shall consist of the following principal items:

.1 One backup set of any integrated circuit or solid-state memory-based plug-in firmware used.

.2 Two complete backup copies of system and application software in installable/executable format on magnetic/optical media compatible with the system furnished.

.3 Two complete backup copies of all purpose made software c/w source code and optical/media.

.4 Three sets of user reference manuals for all standard system and application software.

.5 One set of user reference manuals for all operating system software.

.6 Three sets of printed as-built reference documentation for any special software provided specifically for this contract.

.7 One set of above on magnetic/optical media compatible with the system furnished.

.8 For each licensed software product, all documentation provided by the product manufacturer shall be provided. This includes all reference manuals and any other documents that were provided by the manufacturer. There should be one set of this documentation for each and every piece of equipment provided. Multiple pieces of similar equipment or software require multiple copies of this documentation

2.9 Software License

2.9.1 All software programs supplied as a standard part of System Supplier's products for this project shall be licensed to Owner for use on the system specified herein. Such license shall not restrict Owner from using the software on the system provided hereunder or its replacement. Owner shall have the right to make copies of the software for use on the system provided. Specific requirements of System Supplier's software license are subject to review and approval by Owner and Engineer

2.10 Uninterruptible Power Supply

2.10.1 Provide Uninterruptible Power Supply (UPS) suitable for powering and protection of PLC processor, instruments and modem during the main power source outage.

2.10.2 UPS to be installed in the PLC control panel and communication control panel.

2.10.3 The UPS minimum VA rating shall be: 1500 to suit and PLC control panel applications, IT-0001 communication.

2.10.4 System Design Requirements. The UPS system shall conform to the following standards and features and other features as required:

.1 Capacity 125% of the maximum load with 60-minute full load uninterruptible AC power.

.2 Capacity, peak (minimum) 150% of continuous power rating for 10 seconds.

.3 Frequency stability, battery 3%.

.4 Efficiency, overall on-line 75% minimum.

.5 Operating temperature-humidity 0 to 40°C; 0 to 95% relative humidity, non-condensing.

.6 Recharge time (max) four hours.

.7 Input Voltage: 120VAC at 60Hz +10-15%

.8 Output Voltage: 120VAC at 60Hz +/- 5% at 60Hz

.9 Noise Reduction: ANSI/IEE C62.41 (A)

.10 Surge Suppression: ANSI/IEEE C62.41 (A)

.11 Communications: 10/100BaseT Ethernet SNMP

.12 Outputs: Hard wired alarm contacts.

2.10.5 UPS systems supplied under this contract to suit each PLC control panel enclosure shall be of the same manufacturer. Provide the manufacturer and model of UPS to suit the PLC control panel as specified on the drawings.

.1 Acceptable Manufacturers: Eaton Powerware (1500VA minimum)

2.10.6 Provide wiring for external circuits, including all alarm contacts, shall be brought to grouped terminal blocks located for convenient connection. Provisions shall include suitable marked terminal blocks for connection of No. 12 AWG control wiring and for input/output power conductors as sized on the drawings. Terminal designations shall agree with manufacturer's wiring diagram.

2.10.7 The battery charger and the rectifier shall have the following characteristics:

.1 The rectifier shall convert the incoming AC power to DC power to energize the static inverter. The battery charger shall supply a float current to the batteries to maintain them at a fully charged state while incoming power is being provided. The charging voltage shall be temperature-compensated over the entire operating temperature range to avoid overcharging or undercharging the batteries. The battery charger shall automatically apply an elevated voltage (equalization charge) to the batteries if and as required by the battery manufacturer.

.2 The batteries shall provide backup power for the UPS when incoming commercial power is not available. The batteries shall be leak-proof, sealed, maintenance-free lead-acid type. The batteries shall be integral to the UPS. Batteries shall have capacity to supply the dc power to the UPS while operating at full load for a period of not less than 60 minutes at 25ºC. The batteries shall have an expected life of five years and shall carry a one year warranty.

2.10.8 The solid-state inverter shall employ silicon-controlled rectifiers (SCRs) and other devices for converting direct current power to essentially sinusoidal alternating current power. The static inverter shall conform to the following characteristics and requirements.

.1 Automatic Synchronization: During normal operation, the inverter shall provide power to critical loads. The utility electric system will act as an alternate supply. Inverter equipment shall include stable solid-state devices designed to automatically maintain inverter output in phase with the utility electric system.

.2 Overload, Short Circuit, and Load Loss: The inverter shall have input and output fuses and other equipment necessary to protect from overload, short circuit, and 100% loss of load. Current limiting features shall also be provided.

.3 Loss of Supply Voltages: The inverter shall include protective devices to prevent damage resulting from excursion, loss, or restoration of its synchronization voltage and its dc input voltage and any inrush current occurrences associated with such conditions

2.10.9 Static transfer switch shall use SCRs and other static devices required to automatically transfer loads from the off-line (bypass) to the on-line operating condition and back again. In off line mode, the static transfer switch shall connect clean filtered power to the load. The primary ac line shall be monitored and the load shall be transferred to the inverter if the voltage drops below 85 percent. During on line mode operation, any inverter problem shall cause an instantaneous transfer to the bypass mode.

2.10.10 An output receptacle panel with a variety of NEMA 5, 6, L5, and/or L6 receptacles shall be furnished on the rear of the UPS. The System Supplier shall coordinate the size, number, and type of the receptacles with the equipment as required or as indicated on the drawings

2.10.11 Controls, indicators and alarms shall be provided as a part of the UPS. Control buttons and LED indicators shall be provided on the UPS panel and shall be permanently labelled

2.10.12 Provide the following remote dry alarm contacts, rated 3A, 120VAC to suit the following:

.1 UPS General Alarm

2.11 Surge and Lightning Protection

2.11.1 In addition to other environmental protection specified herein, the complete control system shall be provided with lightning protection. Lightning protection measures shall include the following.

2.11.2 All major components of the system shall have a low resistance ground connection. Grounding system provisions indicated on the drawings shall be modified as recommended by Control System Supplier.

2.11.3 Surge and lightning arresters shall be non-faulting, non-interrupting, and shall protect against line-to-line and line-to-ground surges. Devices shall be solid-state metal oxide varistor (MOV) or silicon junction type, with a response time of less than 50 nanoseconds. Surge protective devices shall be applied for the following:

.1 All power connections to PLCs, instruments and control room equipment. Surge arresters shall be Transtector "ACP-100 Series", Power Integrity Corporation “ZTA Series”, or MCG Surge Protection “400 Series”.

.2 All connections to coaxial-based networked equipment (including CCTV, CATV and ethernet) where any part of the circuit is outside of the building envelope. Surge

arresters shall be Telematic “VP08”, Transtector “TCP Series”, Northern Technologies “TCS-CP3 Series”.

.3 All analog signal circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Surge protection devices shall not impede or interfere with the use of smart transmitter calibration/communication. Protection devices located near the transmitter shall be Telematic “TP48.” Protection devices in control panels shall be Transtector “TSP Series”, Telematic “SD Series”, or Citel “BP1-24.”

.4 All metallic pair (twisted and untwisted) conductor local area network and data highway termination points, where any part of the data highway cable is routed outside of the building envelope. Single-port protective devices shall be Phoenix Contact “TRABTECH C-UFB/CN-UFB Series” or Telematic “NP Series.”

.5 All serial, PLC data highway, and remote I/O network termination points where any part of the circuit is routed outside of the building envelope. Surge protection devices shall be Transtector “DLP Series” (RS-232); Transtector “FSP4000MC Series” (RS-422); Phoenix Contact “TRABTECH D-UFB” (in-line) or “MT Series” (panel-mount); Citel “E280 Series”.

.6 All telephone lines at points of connection to the system. Protection devices for dial-up circuits shall be Transtector “TSJ Series”, Telebyte “Model 22PX”, Citel “BP1-T”, or approved equivalent. Protection devices for full period circuits shall be Transtector “LMP Series”, Northern Technologies “DLP-S Series”, or Circuit Components, Inc. “SPR-TM Series.”

2.11.4 Supply and install surge and lightning protection on all individual I/O and communications terminations that originate from instrumentation or devices located outside of the building.

2.11.5 Each 120VAC panel or terminal junction box to have individual DIN rail mounted protection units.

2.11.6 Each 120VAC/DC discrete input originating from devices outside of the building to be protected by DIN rail mounted surge protection units located in the respective new control panels at the field wiring terminal blocks.

2.11.7 Each analog input originating from instrumentation and/or devices outside of the building to be protected by DIN rail mounted surge protection units.

2.11.8 Provide a dedicated ground to suit the lightning protection.

2.12 Instrumentation, Control, Communication, and Special Field Wiring

2.12.1 Conform to the requirements of Division 16.

2.12.2 Run all wiring in conduit or duct (underground wire) unless otherwise specified. Refer to this division and to the drawings for additional information, requirements and details.

2.12.3 Provide minimum 20% spare wiring or two conductors (one pair) whichever is greater for each control conduit. Spare control wire shall be tagged as spare at both ends.

2.12.4 All wires must be tagged with pre-numbered slip-on markers. Allow for up to 10 characters per individual wire. No wrap around markers will be accepted.

2.12.5 Control Wiring (Field)

.1 All control wiring to be stranded, annealed copper conductors, 600V minimum rating 14 AWG, RW90 XLPE, 600V rated conductors to be provided.

.2 Where conductors to be buried in conduit 14 AWG, RWU90, XLPE, 600V rated conductors to be provided.

2.12.6 Instrumentation Cable (Field)

.1 Cable to be 300 V rated and meet CSA, C22.2 No. 239 standard with the following features:

.1 Seven strand copper conductor with TW75 (-40°C) 105°C dry PVC insulation formed into pairs or triads.

.2 Aluminum/polyester tape shield over individual pairs or triads.

.3 Individual shield, seven strand tinned copper drain wire.

.4 Aluminum/polyester tape shield over cable.

.5 Overall shield, seven strand tinned copper drain wire.

.6 Ripcord.

.7 90°C (-40°C) FRPVC jacket.

.2 Cable to be as manufactured by SHAWFLEX LTD. or BELDEN LTD.

2.12.7 Communication and Special Wire and Cable (Field)

.1 The Contractor shall provide all wiring and cable, including connectors, plugs and termination devices required for the wiring of the systems and equipment shown on the drawings, unless otherwise specified.

.2 Provide quantities and lengths of cable and wire type as recommended by the system equipment manufacturers. Do not de-rate any cabling and wire. No wire/cable to be sized less than 18 AWG unless approved by the Engineer or unless a specific requirement of the equipment manufacturer.

.3 Coordinate with the manufacturer and other sections of these specifications to ensure proper conduit type (i.e. metal) and sizes are provided.

.4 All cables and wire to be continuous runs.

.5 Provide, as part of shop drawing submittal, cable and wire specifications and data for each system. Include written proof that cable and wire meets requirements of equipment supplier.

.6 Any wire and cable installed that does not meet the wiring specifications of the equipment manufacturer shall be removed and replaced (including conduits, if necessary), at the Contractor's expense.

.7 All communication cables are to be in 2 inch Rigid PVC conduit.

2.13 Field Devices and Control Equipment

2.13.1 Unless specified otherwise, transmitters shall be two-wire, suitable for operation on 24VDC, with 4-20 mA DC linear output, complete with direct reading local indicators in engineering scales.

2.13.2 Calibration and scale range data indicated may vary during shop drawing review.

2.13.3 Provide quantity and tagging to suit the drawings.

2.13.4 Acceptable manufacturers of control equipment transmitters shall be as specified for the respective field devices.

.1 Control Relays:

.1 Relays indicated to be provided in panels, enclosures, or systems furnished under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall be ULC recognized and shall have not less than double-pole, double-throw contacts.

.2 Control circuit relays shall have silver cadmium oxide contacts rated 10 amperes at 12 VAC. Electronic switching-duty relays shall have gold-plated or gold alloy contacts suitable for use with low-level signals. Relays used for computer input, alarm input, or indicating light service shall have contacts rated at least three amperes. Latching and special purpose relays shall be as required for the specific application. Unless otherwise indicated, all relays shall have an integral pilot light that illuminates to indicate an energized condition.

.3 Heavy duty type, electrically held.

.4 11 pin, DIN rail mounted.

.5 Contacts: DPDT 1 NO, rated 8A at 120V.

.6 LED illumination to indicate relay operation.

.7 Supply Voltage: 24VDC

.8 Approved Manufacturer:

.1 Releco

.2 Struthers-Dunn

.3 Potter & Brumfield

.4 OMRON

.5 Approved Equivalent

.2 Timing Relays (General):

.1 Heavy duty type, solid state, electrically held, automatic reset after de-energizing.

.2 Time delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of ±2 percent of setting

.3 Latching and special purpose relays shall be as required for the specific application. Unless otherwise indicated, all relays shall have an integral pilot light that illuminates to indicate an energized condition

.4 Range and setting to be as shown and field adjustable.

.5 8 or 11 pin, DIN rail mounted.

.6 Contacts: 2 NO and 2 NC, rated 8A at 120V.

.7 LED illumination to indicate timing start.

.8 LED illumination to indicate relay operation.

.9 Supply voltage: 120VAC.

.10 Approved Manufacturer:

.1 Releco

.2 Struthers-Dunn

.3 Potter & Brumfield

.4 OMRON

.5 Approved Equivalent

.3 Panel Circuit Breakers:

.1 Supply and install rail mount type circuit breakers as shown on drawings, suitable for voltage shown and load requirements.

.2 Breakers to be Thermal-Magnetic type complete with auxiliary contacts, (close on trip) on/off switch, test switch, and trip indication.

.3 Breakers to be ETA Series 2210-T.

.4 Loop Isolators (ISO)

.1 Provide and install loop isolation for 4-20mA analogs where more than one device is receiving the analog as an input.

.2 Input to output isolation to take place through an optical coupler and input/output to power isolation to take place through isolated power supplies.

.3 Operating voltage: 24VDC.

.4 Acceptable product:

.1 PRIBUSIN ITC-XX or approved Phoenix Contact equivalentl.

.5 24V DC Power Supply;

.1 Supply and install 24VDC power supplies as shown on drawings or as required by the instrumentation provided.

.2 Regulated dc power supplies for instrument loops shall be designed and arranged so that loss of one supply does not affect any instrument loop or system. Power supplies shall be suitable for an input voltage variation of ±10 percent, and the supply output shall be fused or shortcircuit protected. Output voltage regulation shall be as required by the instrumentation equipment supplied. Multiloop or multisystem power supplies will be acceptable if backup power supply units are provided which will automatically supply the load upon failure of the primary supply. The backup supply systems shall be designed so either the primary or the backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation

.3 Provide dual redundant 24VC power supplies to suit each application. Provide a redundancy module to suit switching of the power source between the primary and secondary power supply

.4 Power supplies to be complete with the following features:

.1 Input: 120VAC, 60Hz 5A minimum or greater as required to suit the application.

.2 Output: adjustable 24-30 (External) VDC regulated supply at 3 amps output with terminal screw connections.

.3 Stability: 0.2 percent

.4 Mounting: Sub panel mounted

.5 Approval: CSA

.6 Enclosure: General Purpose EEMAC 1

.7 Protection: Short circuit and over current

.8 Options: Two wire power supply output (24VDC)

.9 Provide integral protection to suit the ability to parallel the DC output with multiple DC power supplies.

.10 Provide an auxiliary 1A, 120VC, auxiliary contact to suit power supply general alarm.

.11 Manufacturer: Phoenix Contact Quint Power Type or approved Pribusion equivalent.

2.14 Control Panel – General

2.14.1 All new control equipment to be located at Blind River LLPS are to be installed in control cubicles complete with full size door with lockable three point handle to suit control wiring contract drawings. All panels are to be NEMA 4X unless indicated otherwise on drawings. All control panels are to be stainless steel unless indicated otherwise on the drawings.

2.14.2 Contractor is to refer to the Bill of Material included in the contract drawings for each control panel as a reference only. Contractor is responsible for providing the latest models for each specific equipment at no extra cost. Contractor is to confirm all equipment within the control panels are compatible for the intended design. The contractor shall change the model number as required with the approval of the Engineer if a model number is not compatible with the intended design.

2.14.3 General dimensions and arrangements are indicated on the drawings. System supplier shall be responsible for coordinating the console and enclosure sizes and arrangements to accommodate the equipment provided.

2.14.4 Provide a clear lexan viewing window in all control panels that are equipped with PLC I/O chassis to suit external monitoring of all PLC status lights and inputs.

2.14.5 Provide industrial type control panels to suit model and dimensions shown on the drawings. Dimension identified on the drawings are to be considered minimum. It is the responsibility of the control system supplier to increase the dimensions of the control panel, and/or provide additional control panel sections as required to accommodate the all components to be installed within the respective control panel applications. All control panel designs that require additional control sections shall include a full size door to suit each additional section.

2.14.6 All panels furnished by the Contractor shall carry CSA/ULC label to suit the custom fabricated application or be special inspected by the Electrical Safety Authority.

2.14.7 All panels and cabinets shall be provided with interior back and side sub panels for mounting equipment, a minimum of 300mm print pocket, a cable base, modem/LAN switch pans, and a drip shield across the top of the panel.

2.14.8 Self-regenerating desiccant with vapour corrosion inhibitors for moisture and corrosion protection shall be provided for two years operation. The installed date shall be marked on the package.

2.14.9 Pneumatic tubing shall be 6mm OD, soft annealed copper with compression fittings. Tubing and fittings shall be as specified in the miscellaneous piping section.

2.14.10 Compression type bulkhead fittings shall be provided near the bottom or the top of the panel for all field connections. Compression nuts and sleeves shall be provided for the field connections. Indicators, recorders, controllers, and other pneumatic devices shall be provided with plugged test connections and shutoff valves for isolation.

2.14.11 The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 Volts AC with a nominal clamping voltage of 200 volts. Surge protectors shall be of a non-faulting and non-interrupting design, with a response time of not more than five nanoseconds

2.14.12 Provide wall mounted or free standing control panels to suit the respective applications as shown on the design drawings.

2.14.13 Control Panel wiring or Instrument connections and all internal items to be identified with tag number or service with nameplates affixed with double-sided tape.

2.14.14 Control panel wiring or instrument connections and all internal items to be identified with tag number or service with nameplates affixed with double-sided tape. Control panel to be minimum size as indicated on the drawings or larger as required to suit the application.

2.14.15 Control Panel terminal block shall be arranged such that a minimum of 50mm of clear space is left for outgoing wiring termination. If two terminal blocks are side by side, then minimum of 75mm shall be left between terminal blocks.

2.14.16 Low voltage control wiring shall be copper, colour coded, twisted pairs sized and installed in 80%full lay-in plastic panduit ducts. All outgoing wiring to field devices shall be terminated in terminal blocks, 20% spare terminals shall be provided. All terminals and wires shall be numbered. The numbering system will be agreed upon during the shop drawing review stage and is intended to agree with corresponding numbers on the design drawings. All wires terminating under screws as opposed to clamp type terminals shall have spaded lugs installed.

2.14.17 Sub-panels and mounting plates to be 12 gauge CRS finished with white baked on enamel and have suitable breaks and stiffeners to provide a motion free mounting plate when installed.

2.14.18 All panel wiring shall be neatly dressed and run in plastic duct with AC and DC conductors in separate ducts.

2.14.19 Wire/conductor colour coding to be:

.1 Current carrying neutral conductors shall be coloured white.

.2 Line and load AC Power conductors shall be coloured black.

.3 Ground conductors shall be coloured green.

.4 DC signal ground shall be coloured green with white stripes.

.5 DC voltage conductors shall be coloured blue.

.6 Intrinsically safe circuits: Light Blue

.7 Foreign source interlock control circuits - yellow

.8 AC control wiring conductors shall be coloured red.

.9 Signal (4-20 mA) cabling to have PVC outer jacket coloured grey.

.10 Intrinsically safe circuits shall be coloured light blue.

2.14.20 Two separate grounds are to be supplied, one for instrument grounding and one for control circuit grounding. Install grounding so as to keep two grounds isolated (separate). Ground conductors are to be coloured green, with light green used for control circuit ground and dark green for instrument ground. Provide a dedicated ground connection to the building primary ground electrode.

2.14.21 Provide in each panel a minimum of two single pole circuit breakers (sized to suit) for power on/off to main power supply panel circuit.

2.14.22 All panel wiring and testing shall be done in CSA certified control panel shop.

2.14.23 All panel mounted equipment including switches, relays, timers, analog equipment power suppliers, circuit breakers etc., shall be identified with individual lamicoid nameplates. Provide Engineer with nameplate data for review.

2.14.24 The Contractor shall provide the Engineer in writing with a proposed system of terminal wire numbering for approval prior to submitting shop drawings.

2.14.25 All wiring shall be identified with pre-numbered slip-on markers as manufactured by Brady. Slip-on markers shall be sized to suit wire size and type. Where signal cable identification is required, provide each cable with cable number and each wire with individual wire markers. The Contractor shall allow for up to 10 characters and numbers per wire being terminated at the JC.

2.14.26 The low voltage wiring terminal blocks shall be separated with barriers from 120V control and power wiring terminal blocks.

2.14.27 120V control and power wiring shall be stranded copper, colour coded and not smaller than #14 AWG. This control wiring shall be segregated from low voltage control wiring and be installed in separate lay-in plastic panduit ducts, terminated in terminal blocks with 20 percent of spare terminals. Panel wiring shall be neatly dressed and run in Panduit duct with AC, DC, analog, and communications conductors in separate ducts. Allow a minimum of 150mm wide x 100mm deep for incoming field wiring, and minimum 100mm wide x 100mm deep for internal wiring

2.14.28 All wire and cable shall be run in continuous lengths between supply point and the load and/or device termination points. No splices will be allowed.

2.14.29 Adequate slack shall be provided on cable harnesses to permit easy removal of I/O and other printed circuit cards and/or modules and instruments during service or repair.

2.14.30 All wiring to instruments mounted on doors shall be twisted into one bundle and shall cross from the cabinet to the door at a shallow angle using expandable sleeving.

2.14.31 All wiring for signal systems (analog loops) shall be identified as to loop/circuit numbers with approved markers on the cables at all termination points. Signal (analog) wires shall be PVC insulated tinned copper stranded 18 AWG, rated at 300 volts. Conductors shall be in individual pairs with overall shield and drain wire. Signal wiring shall be Belden#9318 (one pair) and Belden #9368 (two pair).

2.14.32 The shields shall be continuous through terminal strips and shall be individually isolated from other shields. The shields shall be connected at the PLC/RIO panel side only and insulated at the field device.

2.14.33 All wiring, including spares, to be terminated and tagged slip-on wire marker at terminal blocks. No termination to marrettes will be accepted.

2.14.34 Employ plastic wire ways, a minimum of 100mm wide x 75mm deep complete with fine fingers, must be suitable size for field and internal wiring. Provide wire way dimensions and layouts to suit the specific requirements of each control panel application.

2.14.35 Segregate signal wiring from control power wiring according to the following categories: Power 12- VAC, Analog 24 VDC, Digital 120VAC and Communication wiring.

2.14.36 Provide Velcro tie wraps (Hubbell or Panduit) for bundling and securing all wiring.

2.14.37 All wiring in the PLC (e.g. terminal block SCADA module, relays, etc.) is to have only one wire per termination point.

2.14.38 Internal wiring not less than #16 AWG 600V single conductor stranded copper with TEW insulation.

2.14.39 Provide Beldon type 1118A, #16 AWG shielded twisted pair of analog signals.

2.14.40 For 120VAC power wiring provide RW 90 #12 AWG with insulation rated at 600VAC.

2.14.41 Provide control panel ventilation and/or dedicated cooling units as required to dissipate heat generated by internal components such that the internal panel temperature is limited to 24 degrees Celsius.

2.14.42 Provide a 12/24 port CAT6 patch panel in each control panel that requires greater than four external CAT6 Ethernet connections.

2.14.43 Provide a fold down laptop table on the inside of the control panel door to suit panels equipped with PLC's

2.14.44 Provide an Ethernet jack on the inside of the control panel door, adjacent to the fold down laptop table.

2.14.45 Approved Panel Manufacturers

.1 Eurobex

.2 Hammond

.3 Hoffman

.4 Approved Equivalent

2.15 Freestanding Vertical Panels

2.15.1 The following paragraphs describe specific requirements for the freestanding vertical panels:

.1 Panel construction shall be an indoor, dusttight, completely enclosed cubicle formed from steel structural members and steel plates. The base shall be formed of steel channels, with flanges extending upwards. The base shall be provided with 12.5mm diameter holes at 300mm centers so that the base can be bolted to the concrete equipment base. Welds, seams, and edges on all exposed surfaces shall be ground smooth. Suitable lifting facilities shall be provided for handling and shipment.

.2 Panel structure shall be suitably braced and of sufficient strength to support all equipment mounted on or within, to withstand handling and shipment, to remain in proper alignment, and to be rigid and freestanding. Top, sides, and back shall be fabricated from USS 10 gauge [3.42mm thick] carbon steel sheets, designed for rear access with hinged back doors. Doors shall not be greater than 600mm wide. Rear access doors shall be fabricated from USS 14 gauge [1.9mm thick] carbon steel.

.3 The front shall be a hinged door fabricated from USS 10 gauge [3.42mm thick] carbon steel sheet and suitably braced and supported to maintain alignment.

.4 Doors shall be essentially full height, having turned back edges and additional bracing to ensure rigidity and prevent sagging. Doors shall be mounted with strong, continuous, piano type hinges. Positive latches, acting from a common door handle, shall hold doors securely compressed at top, side, and bottom against rubber gaskets. A ground strap shall be provided. The door handles shall be recessed type and lockable.

.5 The bottom shall be open, and components shall be arranged for external wiring conduit and piping to enter from below. The top shall be provided with nominal 1 square foot [0.09 m^3] removable access plates, which may be drilled to accommodate external wiring and conduit to be installed from above.

.6 Panel dimensions and general instrument arrangement shall be as indicated on the drawings. The panel dimensions identified on the drawings are minimum requirements. Increase the panel dimensions and/or provide additional control panel sections as required to suit the design of the respective control panel applications. Multiple control section applications shall include a full size access door for each additional section. The panel shall have spare space for future expansion as follows:

.1 20% future terminal blocks

.2 20% spare terminal blocks for each type

.3 20% spare I/O

.4 25% spare space

.7 The I/O chassis installation shall include power supply and communications link such that the chassis is ready to accommodate future I/O modules.

.8 Illumination of panel interiors shall be provided by ceiling mounted lamp fixtures spaced at approximately 760mm and near the door. Fixtures shall be 100 watt, incandescent or fluorescent tube type, with a common "On-Off" switch near each end door. Duplex-grounded receptacles shall be provided for service and maintenance tools at spacing not greater than 1.52m throughout the length of a panel. The lighting and receptacle circuit shall be fused separately from the instrumentation systems.

.9 Thermostatically controlled, fan-driven heaters for condensation control shall be provided. Heaters shall be mounted near the bottom center of the side of the enclosure.

2.15.2 The following door mounted equipment with legend shall be provided as a minimum:

.1 “General Fault” – Red Pilot Light “ON”

.2 “Power OK” – White Pilot Light “ON”

2.15.3 All Free Standing Vertical Panels shall meet the requirements indicated in “Control Panel – General” of this section.

2.16 Wall Mounted Panels

2.16.1 Cabinets, which contain the system components indicated on the drawings, shall be NEMA Type 4 enclosures unless rated otherwise on the drawings, suitable for wall mounting. The enclosures shall be fabricated from USS 14 gauge [1.9 mm thick] stainless steel. Cabinets shall be equipped with full size gasketed doors with hinges and a chromium-plated or stainless steel three-point latch. Cabinets shall also be reinforced and braced to form a rigid assembly. Panels designed for wall mounting shall have 25mm turned back edges and a minimum 51mm air space between the panel and the wall surface. All components on wall-mounted panels shall be mounted so as to be easily removable without requiring rear access to the subpanel. Subpanels shall be 12 gauge CRS finished with white baked on enamel.

2.16.2 All wall-mounted cabinets shall meet the requirements indicated in “Control Panel – General” of this section.

2.17 Terminal Blocks

2.17.1 Supply and install terminal blocks and mounting rails as shown on drawings complete with slip on marking strips (No hand written markers).

2.17.2 Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labelled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Not less than 200mm of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space

2.17.3 Supply and install 30 percent spare terminals or minimum of 10 spare terminals whichever is greater, evenly distributed in pairs across terminal blocks in the junction cabinets (JC). Spare wires to be terminated on spare terminals.

2.17.4 All terminals are to be easily accessible with ample room for termination of field and panel wiring. Supply terminal block partitions for separating instrument analog loops (4-20mA, etc.) from 120VAC terminals. Arrange terminal strips so that power, control wiring, instrument wiring and grounding points are partitioned by terminal block barriers.

2.17.5 Terminal blocks to be as manufactured by Phoenix Contact Ltd. or Wiedmuller or ENTRELEC Terminal Block Ltd. Field & PLC/RTU /JC terminals to be of the disconnect type UK5-MTK-P P or M6/8 SN and, USLKGIO or M6/8P or W series type for ground termination.

2.17.6 All terminal block groupings to be complete with printed sequentially numbered type marking strips (black on white for field term. and black on yellow for PLC/RIO/RTU /JC term.), partition plates, end covers and end clamps. Mounting rail to be DIN 1 type as supplied by polyamide.

2.17.7 All terminals shall be easily accessible with ample room for termination of field and panel wiring. Terminal block partitions shall be supplied for separating instrument loop (4-20mA, etc.) from 120 VAC terminals. Arrange terminal strips so that power, control wiring, instrument wiring and ground points are partitioned by terminal block barriers. In panels with large numbers of terminals, separate rails shall be provided for 120VAC blocks.

2.17.8 Common connection of wires at terminal blocks to be generally connected by jumper bar.

2.17.9 Group markers shall be used for major group, e.g. all signals from an MCC starter.

2.17.10 Knife-switch field terminal blocks shall be provided on all analog 4-20 mA loops to permit easy electrical isolation of loop and connection of ammeter into loop.

2.17.11 Fused terminal blocks with neon “fuse blown” indicator on a knife switch shall be provided for all digital loops to electrically isolate the loop. One spare fuse shall be provided per each 10 digital connection. All fuses or circuit breakers shall be clearly labelled and located for easy maintenance.

2.17.12 One side of each terminal strip shall be reserved for field incoming conductors. No common connections and jumpers required for internal wiring shall be allowed on the field side of the terminal.

2.17.13 250ohm precision resistors shall be provided at terminal blocks where required.

2.17.14 Acceptable Terminal Block Manufacturers:

.1 Weidmuller

.2 Phoenix Contacts

.3 Entrelec

.4 Approved Equivalent

2.18 Control Panel Grounding and Power Distribution

2.18.1 Power shall be supplied to the all field devices and instruments from the respective control panels as indicated on the drawings. Each instrument power circuit shall be protected with a panel mounted terminal block type circuit breaker sized to suit the application. Two 120VAC /24VDC (two Amp minimum) power supplies with power distributor block shall be supplied. The power supplies shall be sized such that one can handle the total 24V DC load. Fused terminal blocks shall be provided to distribute the 24VDC power.

2.18.2 Power fail relay shall be provided for PLC input.

2.18.3 Panel lighting, service outlets, and heater shall be put on a separate 120VAC circuit supplied by a separate power feeder to the panel. Internal panel circuits or loads must not be mixed.

2.18.4 Two separate grounds, one for instrument grounding (i.e. 4-20mA cable shields etc.) and one for control circuit grounding (i.e. case grounds, control circuits, etc.) shall be provided. Install grounding so as to keep two grounds isolated. Ground conductors shall be #6 AWG, coloured green, with white stripes used for instrument grounds and dark green for control circuit grounds.

2.18.5 Vinyl insulated ring type crimp connectors shall be provided for all ground connections.

2.18.6 Supply and install terminal blocks and mounting rails to suit power distribution with slip on marking strips (No hand written markers).

2.19 Selector Switches, Indicating Lights and Push Buttons

2.19.1 All panel mounted indicating lights, LED's, selector switches and pushbutton stations unless otherwise indicated shall be 30mm Allen Bradley 800H or approved Cutler Hammer equivalent. Contact blocks used to switch control voltage shall be heavy duty oil-tight type silver to silver butting type contacts rated 10 amperes continuous at 120VAC. Contact configuration shall be as indicated on the drawings or as required for the application. Contact blocks used on low voltage, analog, or milliampere circuits to have gold plated contacts. For all switches, the number and arrangement of contacts and their function shall be in accordance with the schematic control diagrams indicated and shall suit the specified functional requirements. Position legends shall be engraved on the switch faceplate. Switches used in electronic signal circuits shall have contacts suitable for that duty.

2.19.2 Indicating lights shall be heavy-duty, oil-tight type, with low voltage LEDs. A built-in transformer shall be used for ac service. Legends shall be engraved on the lens or on a legend faceplate. Lights shall be push-to-test type. Indicating lights shall be Allen Bradley 800H or approved Cutler Hammer "Type H".

2.19.3 Push Buttons shall be heavy-duty, oil-tight type. Legends shall be engraved on the push-button faceplate. Contacts shall be rated 10 amperes continuous at 120VAC. Push buttons shall be Allen Bradley 800H or Cutler-Hammer "Type H".

2.19.4 All operator devices shall be complete with legend plate to suit application shown.

2.20 Speed Digital Displays

2.20.1 All speed indications are to be 4-digit digital indicators, 120VAC, 4-20mA input, flush mount.

2.20.2 Acceptable product:

.1 Precision Digital: PD765

.2 Approved Equivalent

3 EXECUTION

3.1 General Instructions

3.1.1 The Contractor shall supply a communications & automation equipment schedule for review prior to submission of any shop drawings. The schedule shall be tabular in form and have a minimum of:

.1 Item system description

.2 Tag number as herein specified or as shown on the drawings.

.3 Reference to specification item number, drawing number and description

.4 Proposed submission date

.5 List of associated equipment. Note all equipment forming part of a system should be submitted at same time.

.6 List of all software as required to set-up/program field devices, including verification that all software is licensed in the name of the owner.

3.1.2 The Contractor is required to commission and demonstrate the operation of the instrumentation control panels, local panels, and all communication panels. The Contractor must demonstrate each cabinet is free of any deficiencies.

3.1.3 The Contractor is required to commission and demonstrate the operation of the UPS and electrical distribution of the HMI/PC enclosure prior to the installation of the SCADA HMI computer.

3.2 Coordination

3.2.1 Carefully examine and monitor for compatibility, any instrumentation and control work provided as part of the work of Sections of the specification, other than the Sections governed by this Section and ensure that all trades involved are aware of any coordination problems or details.

3.2.2 Incompatible work, such as instrument process connections, mounting of equipment, analog, discrete or communication wiring, voltages, or inconsistencies resulting from insufficient coordination of other related work, is to be satisfactorily resolved at no additional cost to the Contract.

3.2.3 When scheduling site inspection, FAT, commissioning, or SAT with the Engineer, allow at least 10 working days advance notice.

3.3 Manufacturer's Services and Certification of Installation

3.3.1 Comply with the requirement of Section 01820 – Demonstration and Training.

3.3.2 Allow in the tender for all the necessary services and expenses of a trained, qualified manufacturer's representative for each device to ensure correctness of installation, testing, start-up commissioning and training. The qualified representative is to:

.1 Provide onsite supervision of installation for the initial and critical stages of the work as agreed to with the manufacturer/supplier and as require by the Engineer.

.2 Supervise testing of equipment. Supervise retesting of equipment at no additional cost.

.3 Provide written certification stating that the work has been completed satisfactorily.

.4 Provide a complete Installation, Start-up Checklist and sign off on the start-up work completed.

.5 Provide operation and maintenance instruction to the Blind River LLPS operating staff.

3.3.3 Provide supervision of installation as required by the manufacturers for all equipment in this Division.

3.3.4 Provide all materials, labour and equipment to make any adjustments to the installation as required by the manufacturer or the Engineer to effect performance.

3.3.5 On completion of installation and testing, obtain certification from the manufacturers that the equipment is installed correctly, is in full operating condition, and is operating in accordance with its design rating. Submit the original certificate to the Engineer.

3.3.6 Include the service of the trained personnel to inspect and commission the equipment when ready for starting and to instruct the operating personnel in the operation and maintenance of the equipment. Time spent on site by the trained personnel must be witnessed by the Engineer.

3.3.7 Include above services for all equipment specified in relation to this Section and as a minimum provide commissioning and training as follows:

.1 Major process equipment – See the list below. Split the specified time into three stages: inspection during installation, start up and commissioning, staff training. Refer to Section 01820 Demonstration and Training.

.1 Flowmeters

.2 Pressure Transmitters

.3 Analyzers

.4 Level Transmitters

.2 Two eight hour days for all other process instrument, where not specially mentioned, of which 0.5 day minimum dedicated to training.

3.4 Panel Inspection & Factory Acceptance Testing (FAT)

3.4.1 Make all of the necessary arrangements with equipment suppliers for panel inspection and FAT prior to delivery.

3.4.2 Schedule the FAT sessions with the Engineer a minimum of 10 working days in advance. Allow enough time for thorough testing and corrections to take place. Provide written indication of the control panels to test as part of the FAT.

3.4.3 Panel inspection and FAT is to be performed in the presence and to the satisfaction of the Engineer, and is to include all devices necessary to simulate actual operating conditions.

3.4.4 Configure the PLC with a suitable “dummy” or shell program, establish communication, temporarily wire digital inputs to test switches and digital outputs to indicating lights, analog inputs to 4-20mA generators and analog outputs to panel meters to demonstrate functionality

of all hardware and software. Exercise the hardware (i.e. I/O, communications, panel mounted instruments, etc.) with appropriate software in place to demonstrate/monitor operation of all connected equipment and wiring.

3.4.5 Configure and demonstrate all network connections to the respective control panels. Provide temporary network connections to "test devices" to demonstrate the operation of all PLC communications modules, including:

.1 Fiber

.2 Ethernet CAT6

3.4.6 Make the necessary corrections as indicated by the tests, or as directed by the Engineer. Shipment of equipment to site is contingent on the Engineer's approval.

3.5 Installing Instruments

3.5.1 Install, test, calibrate and commission instruments in accordance with this Specification, drawings for construction and any special details where they apply. Where installation details are not indicated, conform to the manufacturer's instructions and/or API RP550 recommendations.

3.5.2 Unless otherwise shown or specified, all required mounting hardware, enclosures, terminations, junction boxes, etc. are to be provided. Refer to the tender drawings and the manufacturer's documentation to confirm the necessary hardware and construction for specific mounting assemblies where such details are not specified herein.

3.5.3 Do not mount instruments on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration. Do not mount instruments below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.

3.5.4 Prepare metal surfaces and paint supports or frames the same colour as the member the complete assembly is mounted on.

3.5.5 Locate instruments and their associated sensors, local isolation valves, isolation switches and other related accessories so that they are readily accessible for operation, maintenance or removal. Ensure that instrument displays are properly oriented so as to be easily viewed. Unless otherwise shown or specified, mount instruments 1.4 m above finished floors, grade or platforms. Allow for cabinet floor-pad heights when locating panel instruments. Any instrument that is not easily accessible for operation or maintenance, or any indicator that is not easily and readily visible must be relocated as directed by the Engineer at no charge to the Contract.

3.5.6 When drilling or installing conduit entry points instruments, protect internally mounted equipment from vibration, shock and metal filings. Conduit entries must maintain the equipment or panel EEMAC rating.

3.5.7 Field measure lengths for transducer cables, and similar items prior to ordering. Mechanically protect cables and adequately secure in place without sagging.

3.5.8 For location, power, mounting and other related details, refer to the manufacturer's installation details and to the instrument and electrical drawings issued for construction.

3.5.9 Provide isolation valves for all instruments.

3.5.10 Protect all instruments with capillaries throughout their length without sagging, by using painted/galvanized angle iron and clips. Avoid sharp bends in capillary and coil any excess close to the sensor end. Protect the coiled capillary by clipping to a steel plate or other safe method.

3.5.11 Sensing and sample lines are to be run in ½ inch stainless steel tubing with “Swagelok” compression type fittings.

3.5.12 Electrically heat trace all instrument sensing and sample lines liable to freezing.

3.5.13 Install process sample piping and sensing lines to avoid accumulation of vapour or gas (in liquid service) and of liquid or condensate (on vapour or gas service) as appropriate.

3.5.14 Position instruments so that they do not block or obstruct walkways or access points and provide adequate space around installation for removal of covers, etc.

3.5.15 Standard instrument process connections of ½” NPT female are to be provided (pressure gauges normally ½ inch NPT male).

3.5.16 Instrument support brackets may not be welded to process piping or equipment, but should generally be pedestal or wall mounted.

3.5.17 Run field cables for analog signals in separate conduit from 120VAC/24VDC control or 120VAC power supply cables.

3.5.18 Use field junction boxes suitable for the area classification to “marshal” groups of signals of the same type in an area and cable back to buildings and local control panel with multicore cables.

3.5.19 Junction boxes may be FRP (fibreglass reinforced plastic) or similar material suitable for the area and rust and weather resistant. Terminals inside field junction boxes are to be DIN rail mounted.

3.5.20 Provide the necessary mechanical shields, mounting plates to properly secure and protect transducers. Provide stilling wells wherever turbulence can adversely affect measurement.

3.5.21 Once an instrument has been inspected by the Engineer and initially calibrated, it is to remain powered up at all times unless servicing the instrument itself. Immediately install keepers on all panel circuit breakers powering instruments.

3.5.22 Instrument calibration, setpoints and other programmable parameters are to be confirmed with the Engineer during on-site inspection as soon as site conditions are sufficiently ready. Final calibration values may and will be different than nominal values specified in the Product Data Sheet at no extra cost to the Contract.

3.6 Identification and Tagging

3.6.1 Identify systems and equipment in accordance with the provisions of this specification. Systems and equipment include:

.1 All items furnished under this contract.

.2 Items defined in this contract that require identification;

.1 Identification of wiring and electrical equipment as specified and tagged in the PLC I/O list.

.2 Provide a Tag text list to Engineer for approval prior manufacturing.

.3 Provide tags of the following materials:

.1 Field instrument tags are 10 gauge, stainless steel with black lettering.

.2 Equipment tags are 10 gauge, stainless steel with green lettering.

.3 Control panels tags are to be Lamicoid, black background with white lettering.

.4 Size tags as 100 x 40 with maximum three lines, front height as 6.5mm.

.5 Use text with the following characteristics:

.1 Lettering – Uppercase

.2 Font – Times New Roman

.3 Style – Regular

.4 Size – Maximum to fit label width, minimum 3mm

.5 Character spacing – Normal

.6 Justification – Center lettering on each line

.6 Submit with the Shop Drawings, a typed list indicating all nameplates wording as well as proposed types, sizes and styles.

.7 Prior to installation of new items, apply identification nameplates to each instrument, panel, telemetry device and controller.

.8 Lamicoid nameplates shall be provided for each piece of instrumentation equipment. (For interior or exterior panel mounted equipment).

.9 Mount tags so that they are readily apparent and legible. Place tags within a height range of 1200mm to 1650mm if possible. Do not obscure or mount over other nameplates, labels or tags.

.10 Nameplates shall be fastened with corrosion resistant screws.

.11 Nameplates on field equipment and external to control panels to be black background with white lettering. Internal panel labels to be black background and white lettering.

.12 Identify transducer and miscellaneous hardware with stainless steel labels denoting tag name only, permanently fastened to either the transducer housing or cable.

.13 Wiring:

.1 Identify all PLC I/O signals on field terminal rails with appropriate tag.

.2 Identify all wiring at both ends with appropriate, permanent wire markers.

3.7 Controller Application Program Installation, Testing & Control System Commissioning

3.7.1 When field pre-commissioning of the instrumentation and control system has been completed as specified above, the system is ready to load control application program.

3.7.2 Coordinate all commissioning activities. Supply all labour and materials required to coordinate instrument and controls commissioning with other trades.

3.7.3 Provide all labour and materials necessary to commission and operate the system for the duration of the run or period. During this time all equipment is expected to run in automatic mode.

3.7.4 Perform the commissioning activities associated with operation of the treatment plant process equipment under control by the software program, as directed by the programmer.

3.7.5 Take all necessary steps to ensure that all equipment or parts of the system successfully tested and deemed ready for their intended use stay in operation.

3.7.6 Provide clear signs/marking as to required status on the equipment that is to remain powered up, left in Auto, or remain Off, etc., during the commissioning period. Agree with the Engineer on the method for achieving this and ensure safe and compliant operation of the equipment at all times.

3.7.7 Adopt a recognized lock-out policy and agree to it with the Engineer. Coordinate the requirement for lock-out for safety reasons with the scheduled commissioning program so that all equipment needed to commission a process/area is available concurrently.

3.7.8 Make minor corrections/additions to wiring, terminations, instrument calibrations and settings as normally expected necessary to resolve operational problems during commissioning at no additional cost.

3.8 Site Acceptance Testing (SAT)

3.8.1 When initial site inspections and commissioning of the instrumentation and the control system is satisfactorily complete, schedule with the Engineer to demonstrate the entire system is ready to start control application program commissioning.

3.8.2 Include for the presence of qualified instrument technicians and equipment manufacturer's representatives to supervise the test if requested by the Engineer. Testing is to demonstrate the proper operation of all field physical input and output signals of the PLC system under actual operating conditions to the satisfaction of the Engineer. This includes proper operations between PLCs, and all peripheral devices. Supply all labour, instruments and materials to perform the testing.

3.8.3 The SAT must be satisfactorily complete prior to applying for a Certificate of Substantial Performance.

3.8.4 Deliver all testing software, panel keys etc. to the Engineer.

3.8.5 Provide test programming to suit all PLC applications, and provide the same I/O and communications demonstration performed during the FAT.

3.8.6 The contractor shall provide the following documentation 10 working days prior to the scheduled SAT:

.1 SAT document

.2 Final HMI screenshots

.3 Pre-startup report from the control panel supplier for each respective control panel

.4 An I/O verification testing report with initials to verify completion of each I/O, including analog I/O ranges.

.5 Vendor startup reports for the respective equipment packages.

.6 Alarm dialer testing report, including client/operator notification list and escalation configuration.

.7 A SAT schedule of specific equipment being tested each day.

.8 Provide network media certification documents prior to the deployment of any server or communication hardware in the field. The contractor is required to provide copies of the network media test reports to the Engineer.

.9 Alarm Dialer Testing Report, including client/operator notification list and escalation configuration.

.10 Completion of software FAT deficiencies.

3.9 Training

3.9.1 Comply with the requirements of Section 01820 – Demonstration and Training.

3.9.2 Dates personnel receiving training will be coordinated by the Owner.

3.9.3 The training program is to be conducted by qualified instrument technicians and competent manufacturer's personnel experienced both with the product and with instruction, using system operation and maintenance manual data as the basis for demonstrations and instructions.

3.9.4 Training shall take place at the site or at the equipment itself. Operation and maintenance manuals shall be submitted to the Owner a minimum of 30 days prior to the training occurring.

3.9.5 The training program is to include routine maintenance of the equipment.

3.9.6 The site training program must be complete prior to application for a Certificate of Substantial Performance of the work.

3.9.7 Pay all costs associated with the training program, with the sole exception of salaries associated with the operating personnel being trained.

3.10 Process Performance Operation

3.10.1 Provide all labour and materials necessary to support the process and the instrumentation and control system for the duration of the contract performance run. During this operation all equipment is expected to run in automatic mode.

3.11 Warranty and Guarantee Period Activities

3.11.1 During the two year warranty period, hardware service should be provided by a factory trained service representative who shall be on-site within 24 hours of a service request, seven days/week, including weekends and holidays. The service representative shall be equipped with all necessary tools, testing equipment, spare parts, and expertise to perform the service in one visit.

.1 For each service call submit a report giving the following information:

.1 Part numbers, description and prices for items replaced.

.2 Revised hard copy/soft copy listings of program changes.

.3 Hours worked by maintenance personnel.

.4 Reason for the service call, and whether preventative, unscheduled or corrective maintenance was carried out.

.5 Name of representative present during repairs. Explain the problem and solutions to the Owner representatives.

.6 Description of problem as discovered on arrival at site and itemized report of activities performed to isolate and correct problem.

.7 Identification of any required actions to prevent similar future occurrence.

.8 Name of attending operations representative, time of call and time of arrival on site.

.2 A single contact point shall be provided for all hardware such that the Owner's representative need only call a single phone number irrespective of which piece of hardware has failed.

.3 Spare Components/Firmware & Software Upgrades:

.1 The supplier should have access to a dedicated spare parts inventory for each component provided. Parts shall be available within 24 hours of a service parts request, seven days/week.

.2 Include key spare parts that are not normally available immediately from stock, in the Recommended Spare Parts List.

3.12 Installation of Equipment

3.12.1 Provide all necessary labour, equipment, tools, anchor bolts, etc., for the complete installation of all equipment specified under this Division.

3.12.2 Install all equipment in a workmanlike manner and in accordance with the manufacturer's drawings, instructions and/or under the direction of his qualified technical representative unless otherwise specified or instructed by the Engineer.

3.12.3 All communications equipment requiring fiber optic communications shall be verified by a light meter to demonstrate that the fiber optic media is correctly installed to suit the application.

3.12.4 All fiber optic,serial and Ethernet connections shall be tested and verified operational.

3.12.5 All communication cables, including serial and Ethernet shall be continuous, with no splices or junction points.

3.12.6 Existing PLC automation, SCADA HMI's and communications networks must remain in service for the duration of the contract. The Contractor must obtain written approval from the Engineer and owner prior to integrating the new I/O and communications links into the existing ICPs.

3.12.7 A representative from the Owner must be present during any interruption to existing SCADA networks. The Contractor shall coordinate the attendance of the Owners representatives.

3.13 Data Communications Outlet Installation

3.13.1 Install all Ethernet cable in accordance with manufacturer's recommendations.

3.13.2 Ethernet cable runs in control rooms, offices or other rooms with drywall shall be concealed behind the walls and terminate in a wall mounted jack.

3.13.3 All other Ethernet cable runs shall be neatly dressed and terminated both ends with a flush or wall mounted jack.

3.13.4 All outlets shall be installed in the following manner:

.1 Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. In hollow wall installations where box eliminators are used, excess wire can be stored in the wall. No more than 300mm of slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack may be neatly coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

3.13.5 In addition, each cable type shall be terminated as indicated below:

.1 Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-B document, manufacturer's recommendations and/or best industry practices.

.2 Pair untwist at the termination shall not exceed one half an inch for Category 6 connecting hardware.

.3 Bend radius of the cable in the termination area shall not be less than four times the outside diameter of the cable.

.4 The cable jacket shall be maintained as close as possible to the termination point.

.5 Data jacks shall occupy the top positions on the faceplate. Data jacks in horizontally oriented faceplates shall occupy the left most positions.

3.14 Network Connections

3.14.1 Configure all new fibre patch panels, network switches, media converters, PLC's, TVSS's, wall jacks, copper patch cords and other devices as required to provide a complete and functional communications systems as specified in this section.

3.15 LAN Commissioning

3.15.1 All IP addresses to be supplied by the Engineer.

3.15.2 Install and connect new Ethernet cables as shown on the drawings.

3.15.3 Configure, test and demonstrate to the Engineer the correct functioning of the PLC SCADA LAN by demonstrating communications between the each device and/or control panel connected to the LAN and a test device (i.e. a laptop provided by the Contractor and equipped with software to suit the communications demonstration).

3.16 Supervision and Commissioning

3.16.1 A supervision and commissioning period shall be allowed for by the Contractor for his supplier to thoroughly check the final installation and performance of each individual piece of equipment, to check each loop control, to start up the equipment and to instruct the Plant Operator on the operation and maintenance of the system. The work shall also include site supervision of the installations where necessary, repair and/or adjustments to the supplier's equipment, and co-ordinate the field supervision by other suppliers and the Contractor within their areas of responsibility.

3.16.2 The start-up procedures will not be carried out without the co- operation and presence of the Engineer. The Contractor shall be responsible for co-ordinating the work, and for making his supplier available to completely commission the entire control and instrumentation system so that it is in perfect running order. The cost of this supervision and commissioning by the supplier for the Contractor shall be total included for in the Contractor's tender. No extra accommodation or meal expenses will be paid. The Contractor remains responsible for a complete and working system, in full accordance with these documents, and at the price bid in his tender.

3.16.3 The Contractor shall obtain written approval from the Engineer, Owner, and Operator prior to modifying the existing main SCADA system.

3.16.4 The contractor is required to complete all instrument forms in advance of any SAT. The forms are to be provided to the engineer in advance of the testing.

3.16.5 The commissioning will not be considered complete without a complete, final, and up-to-date test software listing being supplied.

3.16.6 Non-Operational Tests

3.16.7 Verify and demonstrate the operation of all communications links including:

.1 Ethernet communications links to all digital metering devices, and packaged PLC control systems.

.2 Fiber Communications links.

3.16.8 Operational Tests

.1 Demonstrate the operation of all communications systems.

.2 Demonstrate all remote I/O automation control functions.

.3 Provide all required equipment including computers, software, and communications interface cards to suit demonstration of the networks.

3.16.9 The complete control system and instrumentation must be fully operational and without deviancies prior to implementation of the client supplied custom automation programming.

3.16.10 The Contractor shall provide the services of the installing electrician, on site for a period of not less than 15 non-consecutive days to assist in the testing of the client supplied custom automation applications. Any changes or adjustments to field wiring, setpoints, and system operation shall be at no cost.

END OF SECTION

CONTROLLER TAG	WIRING					DESCRIPTION	SIGNAL TYPE	RAW INSTRUMENT RANGE		ENG UNIT RANGE		ENG. UNITS
	PANEL	PLC	RACK	Module	POINT			MIN	MAX	MIN	MAX	
		1	0	0	-	1756-L83E CPU (ControlLogix Controller)	-	-	-	-	-	-
		1	0	1	-	1756-N2 Empty Slot	-	-	-	-	-	-
LLP0111_SI	ICP-0001	1	0	2	0	Low Lift Pump 1 Speed Indication	AI	4mA	20mA			
DP0901_SI	ICP-0001	1	0	2	1	Sodium Hypochlorite Dosing Pump 1 Speed Indication	AI	4mA	20mA			
FIT0111_FI	ICP-0001	1	0	2	2	Discharge Header 1 Flow Indication	AI	4mA	20mA			
AIT0103_AI	ICP-0001	1	0	2	3	RAW Water Channel Residual Chlorine Indication	AI	4mA	20mA			
LIT0111_LI	ICP-0001	1	0	2	4	Intake Well 1 Level Indication	AI	4mA	20mA			
LIT0121_LI	ICP-0001	1	0	2	5	Intake Well 2 Level Indication	AI	4mA	20mA			
	ICP-0001	1	0	2	6		AI	4mA	20mA			
	ICP-0001	1	0	2	7		AI	4mA	20mA			
LLP0121_SI	ICP-0001	1	0	3	0	Low Lift Pump 2 Speed Indication	AI	4mA	20mA			
DP09020_SI	ICP-0001	1	0	3	1	Sodium Hypochlorite Dosing Pump 2 Speed Indication	AI	4mA	20mA			
PIT0111_PI	ICP-0001	1	0	3	2	Discharge Header 1 Pressure Indication	AI	4mA	20mA			
AIT0102_AI	ICP-0001	1	0	3	3	Raw Water Turbidity Indication	AI	4mA	20mA			
LIT0112_LI	ICP-0001	1	0	3	4	Screen Well 1 Level Indication	AI	4mA	20mA			
LIT0122_LI	ICP-0001	1	0	3	5	Screen Well 2 Level Indication	AI	4mA	20mA			
	ICP-0001	1	0	3	6		AI	4mA	20mA			
	ICP-0001	1	0	3	7		AI	4mA	20mA			
LLPFUT3_SI	ICP-0001	1	0	4	0	Future Low Lift Pump 3 Speed Indication	AI	4mA	20mA			
LIT0901_LI	ICP-0001	1	0	4	1	Sodium Hypochhlorite Level Indication	AI	4mA	20mA			
FIT0121_FI	ICP-0001	1	0	4	2	Discharge Header 2 Flow Indication	AI	4mA	20mA			
TIT0XXX_AI	ICP-0001	1	0	4	3	Raw Water Temperature Indication	AI	4mA	20mA			
LIT0113_LI	ICP-0001	1	0	4	4	Low Lift Well 1 Level Indication	AI	4mA	20mA			
LIT0123_LI	ICP-0001	1	0	4	5	Low Lift Well 2 Level Indication	AI	4mA	20mA			
	ICP-0001	1	0	4	6		AI	4mA	20mA			
	ICP-0001	1	0	4	7		AI	4mA	20mA			
LLPFUT4_SI	ICP-0001	1	0	5	0	Future Low Lift Pump 4 Speed Indication	AI	4mA	20mA			
PIT0121_PI	ICP-0001	1	0	5	1	Discharge Header 2 Pressure Indication	AI	4mA	20mA			
AIT0101_AI	ICP-0001	1	0	5	2	Raw Water Channel PH Indication	AI	4mA	20mA			
LIT0001	ICP-0001	1	0	5	3	Diesel Tank Level Indication	AI	4mA	20mA			
	ICP-0001	1	0	5	4		AI	4mA	20mA			
	ICP-0001	1	0	5	5		AI	4mA	20mA			
	ICP-0001	1	0	5	6		AI	4mA	20mA			
	ICP-0001	1	0	5	7		AI	4mA	20mA			
LLP0111_SC	ICP-0001	1	0	6	0	Low Lift Pump 1 Speed Control	AO	4mA	20mA			
LLPFUT4_SC	ICP-0001	1	0	6	1	Future Low Lift Pump 4 Speed Control	AO	4mA	20mA			
DP0901_SC	ICP-0001	1	0	6	2	Sodium Hypochlorite Dosing Pump 1 Speed Control	AO	4mA	20mA			
	ICP-0001	1	0	6	3		AO	4mA	20mA			
	ICP-0001	1	0	6	4		AO	4mA	20mA			
	ICP-0001	1	0	6	5		AO	4mA	20mA			
	ICP-0001	1	0	6	6		AO	4mA	20mA			
	ICP-0001	1	0	6	7		AO	4mA	20mA			
LLP0121_SC	ICP-0001	1	0	7	0	Low Lift Pump 2 Speed Control	AO	4mA	20mA			
LLPFUT3_SC	ICP-0001	1	0	7	1	Future Low Lift Pump 3 Speed Control	AO	4mA	20mA			
DP0902_SC	ICP-0001	1	0	7	2	Sodium Hypochlorite Dosing Pump 2 Speed Control	AO	4mA	20mA			
	ICP-0001	1	0	7	3		AO	4mA	20mA			
	ICP-0001	1	0	7	4		AO	4mA	20mA			
	ICP-0001	1	0	7	5		AO	4mA	20mA			
	ICP-0001	1	0	7	6		AO	4mA	20mA			
	ICP-0001	1	0	7	7		AO	4mA	20mA			
LLP0111_YN	ICP-0001	1	0	8	0	Low Lift Pump 1 Control Mode Status	DI					
LLP0111_MN	ICP-0001	1	0	8	1	Low Lift Pump 1 Running Status	DI					
LLP0111_XA	ICP-0001	1	0	8	2	Low Lift Pump 1 General Fault	DI					
LLP0111_HAN	ICP-0001	1	0	8	3	Low Lift Pump 1 E-Stop	DI					
V0112_ZSO	ICP-0001	1	0	8	4	Motorized Butterfly Valve 1 Open Status	DI					
V0112_ZSC	ICP-0001	1	0	8	5	Motorized Butterfly Valve 1 Close Status	DI					
V0112_YN	ICP-0001	1	0	8	6	Motorized Butterfly Valve 1 Control Mode Status	DI					
V0112_XA	ICP-0001	1	0	8	7	Motorized Butterfly Valve 1 General Fault	DI					

CONTROLLER TAG	WIRING					DESCRIPTION	SIGNAL TYPE	RAW INSTRUMENT RANGE		ENG UNIT RANGE		ENG. UNITS
	PANEL	PLC	RACK	Module	POINT			MIN	MAX	MIN	MAX	
LIT0111_XF	ICP-0001	1	0	8	8	Intake Well 1 Level Transmitter Loss Of Echo	DI					
LIT0121_XF	ICP-0001	1	0	8	9	Intake Well 2 Level Transmitter Loss Of Echo	DI					
FIT0111_XA	ICP-0001	1	0	8	10	Discharge Header 1 Flow Transmitter General Fault	DI					
AIT0101_XA	ICP-0001	1	0	8	11	Raw Water Channel PH General Fault	DI					
	ICP-0001	1	0	8	12		DI					
	ICP-0001	1	0	8	13		DI					
	ICP-0001	1	0	8	14		DI					
	ICP-0001	1	0	8	15		DI					
LLP0121_YN	ICP-0001	1	0	9	0	Low Lift Pump 2 Control Mode Status	DI					
LLP0121_MN	ICP-0001	1	0	9	1	Low Lift Pump 2 Running Status	DI					
LLP0121_XA	ICP-0001	1	0	9	2	Low Lift Pump 2 General Fault	DI					
LLP0121_HAN	ICP-0001	1	0	9	3	Low Lift Pump 2 E-Stop	DI					
V0122_ZSO	ICP-0001	1	0	9	4	Motorized Butterfly Valve 2 Open Status	DI					
V0122_ZSC	ICP-0001	1	0	9	5	Motorized Butterfly Valve 2 Close Status	DI					
V0122_YN	ICP-0001	1	0	9	6	Motorized Butterfly Valve 2 Control Mode Status	DI					
V0122_XA	ICP-0001	1	0	9	7	Motorized Butterfly Valve 2 General Fault	DI					
LIT0112_XF	ICP-0001	1	0	9	8	Screen Well 1 Level Transmitter Loss Of Echo	DI					
LIT0112_XF	ICP-0001	1	0	9	9	Screen Well 2 Level Transmitter Loss Of Echo	DI					
AIT0102_XA	ICP-0001	1	0	9	10	Raw Water Turbidity General Fault	DI					
	ICP-0001	1	0	9	11		DI					
	ICP-0001	1	0	9	12		DI					
	ICP-0001	1	0	9	13		DI					
	ICP-0001	1	0	9	14		DI					
	ICP-0001	1	0	9	15		DI					
LLPFUT3_YN	ICP-0001	1	0	10	0	Future Low Lift Pump 3 Control Mode Status	DI					
LLPFUT3_MN	ICP-0001	1	0	10	1	Future Low Lift Pump 3 Running Status	DI					
LLPFUT3_XA	ICP-0001	1	0	10	2	Future Low Lift Pump 3 General Fault	DI					
LLPFUT3_HAN	ICP-0001	1	0	10	3	Future Low Lift Pump 3 E-Stop	DI					
VFUT3_ZSO	ICP-0001	1	0	10	4	Future Motorized Butterfly Valve 3 Open Status	DI					
VFUT3_ZSC	ICP-0001	1	0	10	5	Future Motorized Butterfly Valve 3 Close Status	DI					
VFUT3_YN	ICP-0001	1	0	10	6	Future Motorized Butterfly Valve 3 Control Mode Status	DI					
VFUT3_XA	ICP-0001	1	0	10	7	Future Motorized Butterfly Valve 3 General Fault	DI					
LIT0113_XF	ICP-0001	1	0	10	8	Low Lift Well 1 Level Transmitter Loss Of Echo	DI					
LIT0113_XF	ICP-0001	1	0	10	9	Low Lift Well 2 Level Transmitter Loss Of Echo	DI					
LIT0901_XF	ICP-0001	1	0	10	10	Sodium Hypochlorite Level Transmitter Loss Of Echo	DI					
LSH0901_LAH	ICP-0001	1	0	10	11	Sodium Hypochlorite Spill Float Alarm	DI					
FIT0121_XA	ICP-0001	1	0	10	12	Discharge Header 2 Flow Transmitter General Fault	DI					
AIT0103_XA	ICP-0001	1	0	10	13	Raw Water Channel Residual Chlorine General Fault	DI					
	ICP-0001	1	0	10	14		DI					
	ICP-0001	1	0	10	15		DI					
LLPFUT4_YN	ICP-0001	1	0	11	0	Future Low Lift Pump 4 Control Mode Status	DI					
LLPFUT4_MN	ICP-0001	1	0	11	1	Future Low Lift Pump 4 Running Status	DI					
LLPFUT4_XA	ICP-0001	1	0	11	2	Future Low Lift Pump 4 General Fault	DI					
LLPFUT4_HAN	ICP-0001	1	0	11	3	Future Low Lift Pump 4 E-Stop	DI					
VFUT4_ZSO	ICP-0001	1	0	11	4	Future Motorized Butterfly Valve 4 Open Status	DI					
VFUT4_ZSC	ICP-0001	1	0	11	5	Future Motorized Butterfly Valve 4 Close Status	DI					
VFUT4_YN	ICP-0001	1	0	11	6	Future Motorized Butterfly Valve 4 Control Mode Status	DI					
VFUT4_XA	ICP-0001	1	0	11	7	Future Motorized Butterfly Valve 4 General Fault	DI					
SP0111_XA	ICP-0001	1	0	11	8	Raw Water Sampling Pump General Fault	DI					
SP0111_MN	ICP-0001	1	0	11	9	Raw Water Sampling Pump Run Status	DI					
PIT0121_XA	ICP-0001	1	0	11	10	Discharge Header 2 Pressure Transmitter General Fault	DI					
TIT0101_XA	ICP-0001	1	0	11	11	Raw Water Temperature General Fault	DI					
	ICP-0001	1	0	11	12		DI					
	ICP-0001	1	0	11	13		DI					
	ICP-0001	1	0	11	14		DI					
	ICP-0001	1	0	11	15		DI					
DP0901_MN	ICP-0001	1	0	12	0	Sodium Hypochlorite Pump 1 Running Status	DI					
DP0901_XA	ICP-0001	1	0	12	1	Sodium Hypochlorite Pump 1 General Fault	DI					
ICP0001_PFR	ICP-0001	1	0	12	2	Instrument Control Panel Power Failure	DI					
ICP0001_GFH	ICP-0001	1	0	12	3	Instrument Control Panel General Fault	DI					
ICP0001_ZSO	ICP-0001	1	0	12	4	Instrument Control Panel Door Open Status	DI					
UPS0001_XA	ICP-0001	1	0	12	5	Instrument Control Panel UPS Fault	DI					
PSU0001_XA	ICP-0001	1	0	12	6	Instrument Control Panel 24VDC Power Supply 1 Fault	DI					

CONTROLLER TAG	WIRING					DESCRIPTION	SIGNAL TYPE	RAW INSTRUMENT RANGE		ENG UNIT RANGE		ENG. UNITS
	PANEL	PLC	RACK	Module	POINT			MIN	MAX	MIN	MAX	
PSU0002_XA	ICP-0001	1	0	12	7	Instrument Control Panel 24VDC Power Supply 2 Fault	DI					
XSH0010_XA	ICP-0001	1	0	12	8	Pump Room Smoke Alarm	DI					
XSH0011_XA	ICP-0001	1	0	12	9	Chemical Room Smoke Alarm	DI					
TSL0010_TAL	ICP-0001	1	0	12	10	LLPS Pump Room Low Temperature Alarm	DI					
TSH0011_TAH	ICP-0001	1	0	12	11	LLPS Pump Room High Temperature Alarm	DI					
TSL0012_TAL	ICP-0001	1	0	12	12	LLPS Chemical Room Low Temperature Alarm	DI					
TSH0013_TAH	ICP-0001	1	0	12	13	LLPS Chemical Room High Temperature Alarm	DI					
	ICP-0001	1	0	12	14		DI					
	ICP-0001	1	0	12	15		DI					
DP0902_MN	ICP-0001	1	0	13	0	Sodium Hypochlorite Pump 2 Running Status	DI					
DP0902_XA	ICP-0001	1	0	13	1	Sodium Hypochlorite Pump 2 General Fault	DI					
GEN0001_YN	ICP-0001	1	0	13	2	Generator In-Auto Status	DI					
GEN0001_MN	ICP-0001	1	0	13	3	Generator Running Status	DI					
GEN0001_XA	ICP-0001	1	0	13	4	Generator General Fault	DI					
ATS0001_JSN	ICP-0001	1	0	13	5	ATS On Normal Power	DI					
ATS0001_JSAA	ICP-0001	1	0	13	6	ATS On Emergency Power	DI					
ATS0001_JN	ICP-0001	1	0	13	7	ATS Normal Power Available	DI					
ATS0001_JSA	ICP-0001	1	0	13	8	ATS Emergency Power Available	DI					
ATS0001_YN	ICP-0001	1	0	13	9	ATS In Auto	DI					
ATS0001_XA	ICP-0001	1	0	13	10	ATS General Fault	DI					
LSH0010_LAH	ICP-0001	1	0	13	11	Building Flood Alarm	DI					
BLD0010_XA	ICP-0001	1	0	13	12	Building Intrusion Alarm	DI					
FSH0010_FAL	ICP-0001	1	0	13	13	Emergency Shower Flow Switch Alarm	DI					
	ICP-0001	1	0	13	14		DI					
	ICP-0001	1	0	13	15		DI					
LLP0111_MH	ICP-0001	1	0	14	0	Low Lift Pump 1 Start/Stop Command	DO					
V0112_VO	ICP-0001	1	0	14	1	Motorized Butterfly Valve 1 Open Command	DO					
V0112_VC	ICP-0001	1	0	14	2	Motorized Butterfly Valve 1 Close Command	DO					
DP0901_MH	ICP-0001	1	0	14	3	Sodium Hypochlorite Dosing Pump 1 Start/Stop Command	DO					
DP0901_ML	ICP-0001	1	0	14	4	Sodium Hypochlorite Dosing Pump 1 Stop Command	DO					
	ICP-0001	1	0	14	5		DO					
	ICP-0001	1	0	14	6		DO					
	ICP-0001	1	0	14	7		DO					
	ICP-0001	1	0	14	8		DO					
	ICP-0001	1	0	14	9		DO					
	ICP-0001	1	0	14	10		DO					
	ICP-0001	1	0	14	11		DO					
	ICP-0001	1	0	14	12		DO					
	ICP-0001	1	0	14	13		DO					
	ICP-0001	1	0	14	14		DO					
	ICP-0001	1	0	14	15		DO					
LLP0121_MH	ICP-0001	1	0	15	0	Low Lift Pump 2 Start/Stop Command	DO					
V0122_VO	ICP-0001	1	0	15	1	Motorized Butterfly Valve 2 Open Command	DO					
V0122_VC	ICP-0001	1	0	15	3	Motorized Butterfly Valve 2 Close Command	DO					
DP0902_MH	ICP-0001	1	0	15	4	Sodium Hypochlorite Dosing Pump 2 Start/Stop Command	DO					
DLR01_XA	ICP-0001	1	0	15	4	Dialer Channel 1	DO					
DLR02_XA	ICP-0001	1	0	15	5	Dialer Channel 2	DO					
DLR03_XA	ICP-0001	1	0	15	6	Dialer Channel 3	DO					
DLR04_XA	ICP-0001	1	0	15	7	Dialer Channel 4	DO					
DLR05_XA	ICP-0001	1	0	15	8	Dialer Channel 5	DO					
DLR06_XA	ICP-0001	1	0	15	9	Dialer Channel 6	DO					
DLR07_XA	ICP-0001	1	0	15	10	Dialer Channel 7	DO					
DLR08_XA	ICP-0001	1	0	15	11	Dialer Channel 8	DO					
	ICP-0001	1	0	15	12		DO					
	ICP-0001	1	0	15	13		DO					
	ICP-0001	1	0	15	14		DO					
	ICP-0001	1	0	15	15		DO					
LLPFUT3_MH	ICP-0001	1	0	16	0	Future Low Lift Pump 3 Start/Stop Command	DO					
LLPFUT4_MH	ICP-0001	1	0	16	1	Future Low Lift Pump 4 Start/Stop Command	DO					
LLPFUT3_VO	ICP-0001	1	0	16	2	Future Motorized Butterfly Valve 3 Open Command	DO					
LLPFUT3_VC	ICP-0001	1	0	16	3	Future Motorized Butterfly Valve 3 Close Command	DO					
LLPFUT4_VO	ICP-0001	1	0	16	4	Future Motorized Butterfly Valve 4 Open Command	DO					

CONTROLLER TAG	WIRING					DESCRIPTION	SIGNAL TYPE	RAW INSTRUMENT RANGE		ENG UNIT RANGE		ENG. UNITS
	PANEL	PLC	RACK	Module	POINT			MIN	MAX	MIN	MAX	
LLPFUT4_VC	ICP-0001	1	0	16	5	Future Motorized Butterfly Valve 4 Close Command	DO					
SP0111_MH	ICP-0001	1	0	16	6	Raw Water Sampling Pump Start/Stop Command	DO					
	ICP-0001	1	0	16	7		DO					
	ICP-0001	1	0	16	8		DO					
	ICP-0001	1	0	16	9		DO					
	ICP-0001	1	0	16	10		DO					
	ICP-0001	1	0	16	11		DO					
	ICP-0001	1	0	16	12		DO					
	ICP-0001	1	0	16	13		DO					
	ICP-0001	1	0	16	14		DO					
	ICP-0001	1	0	16	15		DO					

1 GENERAL

1.1 Related Sections

1.1.1 Section 01330 – Submittal Procedures

1.1.2 Section 01820 – Demonstration and Training

1.1.3 Section 11190 – Pipe and Valve Supports

1.1.4 Section 13100 – Control & Instrumentation

1.1.5 Section 13563 – Pressure and Level Instruments

1.1.6 Section 13565 – Miscellaneous Instruments and Accessories

1.1.7 Section 16010 – Electrical General Requirements

1.2 Scope

1.2.1 This section covers the furnishing of all instrumentation equipment required for the Control & Instrumentation System as indicated on the P&ID drawings and the sections herein.

1.2.2 Principal components of the instrumentation systems shall be as indicated on the P&ID drawings. The Contractor is required to provide all instruments including electronic/electrical and non-electronic/electrical instruments.

1.2.3 Provide product submittal data sheets for all instrumentation supplied under this project in the format identified in the sample forms included at the end of this section.

1.2.4 Section 13100 shall apply to all systems described in this section. All applicable requirements defined in Section 13100 shall apply to equipment and services provided under Section 13560. Equipment and services in this section shall be provided by the Section 13100 – Control and Instrumentation.

1.3 General

1.3.1 The Control System Supplier (CSS) shall select the equipment furnished under this section for its superior quality and the intended performance. The CSS shall install all equipment in accordance with the manufacturer's instructions. Equipment and materials used shall be subject to review and shall comply with the following requirements.

1.3.2 Refer to Division 1 specifications for general equipment requirements which shall apply to all equipment furnished under this section.

1.3.3 Supplementing this section, the drawings indicate locations and arrangement of instruments and enclosures, provide mounting details, and may show device schedules and other information regarding the connection and interaction with other equipment.

1.3.4 Governing Standards for instruments shall be as indicated in Section 13100 – Control and Instrumentation.

1.3.5 All parts, which are exposed to corrosive conditions, shall be made from corrosion resistant materials. CSS shall submit certification that the instrument manufacturer approves the selection of materials of primary elements that are in contact with the specified process fluid to be inert to the effects of the process fluid.

1.3.6 Elevation and Temperature. All instruments shall be designed to operate within a range of elevation and temperature as required.

1.3.7 Power and Instrument Signals. Unless otherwise indicated, electric power supply to the instrumentation equipment will be unregulated 120VAC and emergency electrical power will be from a diesel generator. All line powered instruments suitable for use on these supplies shall be provided with appropriate CSA approval. Line voltage AC powered instrument not CSA certified must bear an Electrical Safety Authority Special Approvals Branch label.

.1 Unless otherwise indicated, all transmitted electronic analog instrument signals shall be 4-20 mA DC and shall be linear with the measured variable.

1.3.8 Environmental Design Requirements: The following defines certain types of environments. These definitions are referred to by name to specify the environmental requirements for individual equipment units.

.1 Computer Room, Air Conditioned:

.1 Temperature: 16 to 25 degrees C.

.2 Relative Humidity: 40 to 60%.

.3 CSA Classification: Nonhazardous.

.2 Inside, Air Conditioned:

.1 Temperature:

.1 Normal: 16 to 25 degrees C.

.2 With Up to 4-Hour HVAC System Interruptions: 5 to 41 degrees C.

.2 Relative Humidity:

.1 Normal: 10 per cent (winter) to 70 % (summer).

.2 With Up to 4-Hour HVAC System Interruption: 10 to 100 %.

.3 CSA Classification: Nonhazardous.

.3 Inside:

.1 Temperature: -29 to 40 degrees C.

.2 Relative Humidity: 10 to 95 % noncondensing.

.3 CSA Classification: Nonhazardous.

.4 Inside, Corrosive:

.1 Temperature: -29 to 40 degrees C.

.2 Relative Humidity: 10 to 95 per cent noncondensing.

.3 Corrosive Environment: Natural gas.

.4 CSA Classification: Nonhazardous.

.5 Outside:

.1 Temperature: -29 to 40 degrees C.

.2 Relative Humidity: 0 to 100 %.

.3 CSA Classification: Nonhazardous.

.6 Outside, Corrosive:

.1 Temperature: -29 to 40 degrees C.

.2 Relative Humidity: 0 to 100 %.

.3 Corrosive Environment

.4 CSA Classification: As shown on Electrical Drawings.

1.3.9 Appurtenances. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation devices shall be furnished as needed for proper performance of the equipment.

1.3.10 Interchangeability and Appearance. To the extent possible, instruments used for similar types of functions and services shall be of the same brand and model line. Similar components of different instruments shall be the products of the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished.

1.3.11 Programming Devices. A programming or system-configuring device shall be provided for systems that contain equipment that requires such a device for routine calibration, maintenance, and troubleshooting. The programming device shall be complete, newly purchased for this project, and shall be in like-new condition when turned over to the Town of Blind River at completion of startup.

.1 At least one smart instrument calibration device shall be provided for every 10 smart instruments. Rosemount model 275 HART Communicator complete with memory pack 100 and AA battery packer or vendor equivalent shall be provided.

1.3.12 Instruments with password-protected configuration settings:

.1 Password protection shall be enabled after instrument configuration is complete.

.2 All passwords shall be submitted to the Owner.

1.3.13 Each transmitter/analyzer shall include embedded HART communication capability.

.1 Instrument shall recognize and support all Universal HART commands.

.2 HART shall operate in point-to-point mode

.3 Instrument HART must be capable of communicating to Emerson AMS software with AMS used to remotely configure and run diagnostics and self verification.

.4 Instrument must come with necessary driver and communication files for a fully HART and AMS compatible system.

.5 Manufacturer to successfully configure, setup, test and obtain approval for HART installation and connection to AMS

.6 All instruments shall be configured at the factory to include the following:

.1 Device tag name

.2 Commissioning date (To be Completed in Field)

.3 Last Calibration date

.4 Device description

.5 Device span

.6 Engineering units

.7 Dampening time

.8 Serial Number

.9 Display data format – based on span and engineering units

.10 Current output character – linear

.11 Output on fault condition – this must be set up to optimize process based on type/criticality of device

.7 Provide a minimum of one (1) smart instrument calibration device for every ten (10) smart instruments, TREX L H P KL W S3 Wireless and Bench Calibration complete with memory pack 100 and AA battery

1.3.14 Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with CSS'S equipment drawings and shall be as close as practical to the tag numbers used on the project drawings and device schedules. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered or tape labels will not be acceptable.

1.3.15 Indoor Installation. Unless otherwise shown or specified, enclosures for all instruments located indoors in dry non-hazardous areas shall be as a minimum EEMAC12. Pump Rooms shall be NEMA 12. Chemical Rooms shall be NEMA 4X.

1.3.16 Outdoor Installation. Unless otherwise shown or specified, instruments located outdoors shall be suitable for the surrounding climate and appropriately installed with:

.1 An EEMAC4 enclosure including gasketed windows for displays, containing a thermostatically controlled heater and disconnect switch – minimum typical enclosure to be an O Brien VIPAK series or equal.

.2 A combined rain/ice/snow protection shield and sun shade for all electronic instruments which are already provided with sturdy EEMAC4 enclosures by the manufacturer. Supply tip-up type hoods for access for routine calibration and maintenance.

.3 Drawing submissions must clearly show the enclosures proposed for each instrument.

.4 Unless otherwise shown or specified, instruments located in areas subjected to flooding shall be provided submergence rated enclosures.

1.4 Nameplates and Tags

1.4.1 All instrument tagging is subject to one change by the Engineer within 90 days of award.

1.4.2 Wire Identification:

.1 Numbered and tagged at each termination.

.2 Tags:

.1 Shrinkable slip-on wire markers with legible machine printed markings and numbers as manufactured by Raychem or similar.

.2 Adhesive or taped-on tags are not acceptable.

.3 Numbering:

.1 Wire numbering format shall be: AN/NNN/ST/RSSNNA(-TT), where:

.1 AN: alphanumeric designation of terminal at field device

.2 NNN: Instrument Control Panel (ICP) number

.3 ST: Signal tag name (device tag and signal designation)

.4 RSSNNA: Terminal inside ICP.

.5 R: PLC rack number.

.6 SS: PLC slot number.

.7 NN: PLC channel number.

.8 A: Polarity (analog signals only).

.9 TT: Interposing relay terminal numbers (discrete output only).

.2 Examples:

.1 Analog: 25/121/LIT12101_LI/10305+

.2 Digital: 7/121/LIT12101_XA/10812

1.4.3 The Contractor shall verify and obtain approval of the proposed wire tagging convention from both the Owner and the Engineer prior to printing and applying wire tags to control circuits and field wiring.

1.5 Submittals

1.5.1 Submittals shall be as required in Section 13100 - Control and Instrumentation System and Section 01330 – Submittal.

1.5.2 Provide the instrument data submission in accordance with the format identified in the sections herein. Each instrument shop drawing submission must be accompanied with a completed Instrument data table Submission Form. Completed instrument form is to be typed (hand written form is not acceptable)

1.5.3 Complete all fields of each Instrument to suit the submission including but not limited to manufacturer, installation, and calibration verifications.

1.5.4 Product Data Sheets. Provide completed product Data Sheets specifying instruments and equipment conforming to ISA specification sheet standards. Complete blank spaces on these sheets with the information noted below and other data pertinent to the equipment and the application.

.1 Use the product data sheet for documenting installation and testing.

.2 Include the following upon initial submission (to accompany Shop Drawings):

.1 Project Name

.2 Tag number and description.

.3 Manufacturer, Model and Part Numbers.

.4 Identification Nameplate details.

.5 The product manufacturer and the supplier or representative.

.6 The complete model and catalogue numbers including special options.

.7 The available adjustment ranges and the project operating ranges.

.8 Web link for each product manufacturer.

.9 On each sheet, add the following information following field calibration:

.1 Serial numbers.

.2 Date of installation.

.3 Date, time and person who performed calibration.

.4 Calibration data.

.5 Input, output, and error at 0, 25, 50, 75, 100% of span for analog instrument.

.6 Switch setting, contact action, and dead band, if applicable, for discreet elements.

.7 Certification by installer and acknowledgement by contractor.

.8 Special procedures and equipment required to duplicate calibration.

.9 Comments, including calibration changes, repair or replacement works performed.

.10 Add the following upon final submission (immediately following site acceptance):

.1 Signature by the Contractor and the Engineer indicating acceptance.

.2 Phone and fax numbers of contact person for product support/service.

.3 Provide a completed Instrumentation Installation “Checklist” form for each instrument.

1.6 Delivery, Storage, and Shipping

1.6.1 Delivery, storage and shipping shall be as required in Division 1 and Section 13100.

1.7 Spare Parts

1.7.1 Spare parts shall be provided as following: duplicated full set of lamps for indicating lights, terminal blocks, fuses, breakers, relays and timers.

1.7.2 Supply spare parts required to commission instruments. Include five spare fuses of each type for each instrument panel.

2 PRODUCTS

2.1 Individual Device Specifications

2.1.1 Individual instruments and related devices shall be provided as specified in Division 11 – Equipment, Division 13 – Instrumentation, Control and SCADA, and Division 16 – Electrical.

3 EXECUTION

3.1 General

3.1.1 Contractor is responsible but not limited to the following work:

.1 Required Submittals

.2 Equipment and ancillaries

.3 Instructions, details, and recommendations to, and coordination with the Contractor for Certificate of Proper Installation

.4 Verify readiness for operation

.5 Verify the correctness of final power and signal connections (lugging and connecting)

.6 Adjusting and calibrating

.7 Starting up

.8 Testing and coordination of testing

.9 Training

3.1.2 For new equipment not provided under Section 13560 – Instrumentation General Requirements and related subsections, but directly connected to equipment required by Section 13650 – Instrumentation General Requirements and related subsections:

.1 Obtain manufacturers' information on installation, interface, function, and adjustment.

.2 Coordinate to allow required interface and operation with Instrumentation.

.3 For operation and control, verify that installations, interfacing signal terminations, and adjustments have been completed in accordance with manufacturer's recommendations.

.4 Test to demonstrate required interface and operation.

.5 Provide a written report with recommendations for remedial action if equipment is not operating satisfactory or not installed according to manufacturer's instructions.

3.1.3 During field commissioning of the process equipment and the control and instrumentation equipment, work hand in hand with the other trades people, including the engineer, to facilitate hardware and software commissioning.

3.1.4 The flow meter supplier shall provide site services as required to facilitate flow meter installation including factory representative supervision during installation of welding nipples (to confirm position and angle), confirmation of sensor alignment at spool piece manufacturing site, site supervision during installation of feed-through sockets and transducers, parameter determination, commissioning, calibration and training

3.1.5 Make provisions to attend the site to review the installation of the instrument, in advance of testing/commission, applying power to the unit and exposing the flow element to the media intended for flow monitoring.

3.1.6 All configuration software and connection cables shall be provided for each instrument as needed for the application. The appropriate software must be provided in order for the instrument to be configured properly without further acquisitional actions required.

3.2 Instrumentation Installation Requirements

3.2.1 Additional instrumentation installation requirements are specified in Section 13100 – Control and Instrumentation.

3.2.2 Instrumentation field wiring shall be continuous, no splices.

3.2.3 Complete an Instrumentation Installation Checklist Form and Instrumentation Calibration Form for each instrument that is tested and commissioned. Testing and commissioning of the instruments will be considered incomplete unless the respective instrument is provided with an Instrumentation Calibration Form, with all fields completed. The contractor shall provide a typed version of all completed calibration forms to be included in the maintenance manual.

3.2.4 Field Calibration. After each instrument has been installed, a technical representative of CSS shall calibrate each instrument and shall provide a written calibration report for each instrument, indicating the results and final settings. The adjustments of calibrated instruments shall be sealed or marked, insofar as possible, to discourage tampering. Instrument calibration shall be done before checkout of the system operation. A typical instrument calibration form and Instrumentation Installation Checklist form is attached to the end of each section.

3.2.5 Systems Check. A technical representative of CSS shall participate in the checkout of instrumentation systems. Systems check requirements shall be as specified in Section 13100 – Control and Instrumentation.

3.2.6 Installation Test Equipment. Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by CSS for the duration of the testing work and this test equipment will remain the property of CSS.

3.2.7 Mounting of Field Instruments. Instruments shall be mounted so that they can be easily read and serviced and so that all appurtenant devices can be easily operated. Installation details for some instruments are indicated on the drawings. Where installation details are not indicated, the installation performed by the CSSs shall conform to the manufacturer's instructions and/or API RP 550 recommendations.

.1 Individual analog signals shall be run shielded multi-conductor cables, however multiple 4-20mA signals may not be combined into a single multi-conductor cable.

.2 Unless otherwise shown or specified, all required mounting hardware, enclosures, termination's, junction boxes, etc., shall be provided. Refer to the tender drawings and the manufacturer's documentation to confirm the necessary hardware and construction for specific mounting assemblies where such details are not specified herein.

.3 No instruments shall be mounted on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration. No instruments shall be mounted below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.

.4 Metal surfaces shall be prepared and supports or frames shall be painted the same color as the member of the complete assembly is mounted on.

.5 Unless otherwise shown or specified, instruments shall be mounted 1.4m above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments. Instruments that are not easily accessible for operation or maintenance, or indicator that is not easily and readily visible must be relocated as directed by the Engineer at no cost to the contract.

.6 When drilling or installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. Conduit entries much maintain the equipment or panel EEMAC rating.

.7 Lengths for transducer cables and similar items shall be field measured prior to ordering. Cables shall be mechanically protected and adequately secured in place without sagging.

.8 All instruments shall be provided with isolation valves

.9 All instrument cables shall be protected with capillaries throughout their length without sagging by using painted/galvanized angle iron and clips. Avoid sharp bends in capillary and coil excess close to the sensor end. Protect the coiled capillary by clipping to a steel plate or other safe method.

.10 Sensing and sample lines shall be run in ½" stainless steel tubing with "Swagelok" compression type fittings.

.11 Install process sample piping and sensing lines to avoid accumulation of vapor or gas in liquid service and of liquid or condensate on vapor or gas service as appropriate.

.12 Instruments shall be positioned so that they do not block or obstruct walkways or access points and adequate space shall be provided around installation for removal of covers, etc.

.13 Instrument support brackets shall not be welded to process piping or equipment, but should generally be pedestal or wall mounted.

.14 Field cables for analogue signals shall be run in separate conduit from 120V AC/24VDC control or 120VAC power supply cables.

.15 Field junction boxes suitable for the area classification to "marshal" groups of signals of the same type in an area and cable back to buildings and local control panel with multi-core cables shall be used.

.16 Junction boxes may be FRP (fiberglass reinforced plastic) or similar material suitable for the area and rust and weather resistant. Terminals inside field junction boxes are to be DIN rail mounted.

.17 Once an instrument has been inspected by the Engineer and initially calibrated, it is to remain powered up at all times unless servicing the instrument itself. Keepers shall be installed immediately on all panel circuit breakers powering instruments.

.18 Instrument calibration, setpoints and other programmable parameters are to be confirmed with the Engineer during on-site inspection as soon as site conditions are sufficiently ready. Final calibration values may be adjusted to values different than the nominal values specified in the Product Data Sheets at no extra cost to the contract.

.19 Final calibration, setpoints and other programmable values must be documented by the CSS, and provided as submittal

3.3 Field Quality Control

3.3.1 General:

.1 Coordinate Instrumentation testing with the Owner and Engineer.

.2 Notify Engineer of Performance Test schedule four (4) weeks in advance of the proposed start date of the test.

.3 Engineer/Owner may actively participate in tests.

.4 Engineer/Owner reserves right to test, or retest specified functions.

.5 Engineer’s decision will be final regarding acceptability and completeness of testing.

3.3.2 Onsite Supervision:

.1 Retain Instrumentation equipment factory representative to supervise and coordinate onsite instrumentation installation, testing and commissioning activities.

.2 Instrumentation equipment factory representative shall be onsite during onsite work specified herein and the respective instrumentation subsections.

3.4 Commissioning

3.4.1 The Control System Supplier (CSS) shall provide, test and commission all panels and instrumentation required under Division 13 – Instrumentation, Control and SCADA based on superior quality for the intended application and performance. The contractor shall install all equipment and instrumentation in accordance with the manufacturer's instructions.

3.4.2 Scope of Work

.1 Contractor to install equipment provided by the Control System Supplier in accordance with contract drawings and in accordance with manufacturer’s instructions.

.2 Engineer to develop and integrate the SCADA control systems into the instrumentation PLC.

.3 Control System Supplier shall provide, test and commission all panels and instrumentation that is required in accordance with the contract drawings and specifications.

.4 Engineer to confirm hardware installation and instrumentation functionality reflects the contract drawings as presented by the Control Systems Supplier.

3.4.3 The control systems supplier shall participate in commissioning of Instrumentation equipment, including any and all ancillary systems, as well as be available to support commissioning of the complete control system.

3.4.4 The control systems supplier is to support commissioning of the Systems Engineer during commissioning of the complete control system.

3.4.5 Prior to Facility Startup and the Performance Evaluation period for each facility, inspect, test, and document that associated Instrumentation equipment is ready for operation. Divide Functional Test for each facility into two parts.

3.4.6 Preparation for Testing: The control system supplier is to test and document that the instrument is ready for operation, the engineer is to witness and review the suppliers work in preparation for the coming tests.

3.4.7 Functional Test Part 1: Performed by control systems supplier provider to test and document that Instrumentation, excluding Engineer or Owner provided applications software, is ready for operation

.1 I/O Tests: Ensure that wires connecting field- and panel-mounted equipment to PLC input and output modules are correctly terminated.

.1 For all input and output points, perform a complete continuity test.

.2 For digital input points, separately test the operation of each signal-generating device.

.3 For digital output points, separately test the operation of each signal-receiving device.

.4 For analog input points, separately test the operation of each signal-transmitting device.

.5 For analog output points, separately test the operation of each controlled device.

.6 At least two weeks before commissioning is to begin, submit three copies of a formal Input/Output test report to the Engineer to review.

.2 Loop/Component Inspections and Tests:

.1 These inspections and tests will be spot checked by Engineer.

.2 Contractor to ensure they have the right tools such as signal generator to read and generate I/O signals to complete a full loop check from PLC Panel terminal block to field device.

.3 Check Instrumentation for proper installation, calibration, and adjustment on loopbyloop and componentbycomponent basis.

.3 Maintain I/O Test Reports, system problem reports, valve adjustment sheets, and component calibration sheets at site, and make them available to Engineer at all times.

.4 Engineer reviews I/O Test Reports, system problem reports and component calibration sheet and spot-checks their entries periodically, and upon completion of Functional Test Part 1. Contractor to correct deficiencies found.

3.4.8 Functional Test Part 2: Combined effort between Contractorand Engineer to confirm Instrumentation, including applications software, is ready for operation prior to the SAT.

.1 Prerequisite: Completion of Functional Test Part 1.

.2 Joint test with Engineer and Owner. Repeat I/O Tests, verifying signal from field device to HMI.

3.4.9 Final SAT:

.1 This is completed jointly with Contractor, Engineer and Owner. Demonstrate each required function on a paragraphbyparagraph, loopbyloop, and sitebysite basis.

.2 Perform local and manual tests for each loop before proceeding to remote and automatic modes.

.3 Where possible, verify test results using visual confirmation of process equipment and actual process variable. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.

.4 Work handin hand with systems engineer to ensure the field equipment and custom application software is satisfactory.

.5 Make updated versions of documentation such as datasheets and O&M's required for Performance Test available to Engineer at site, both before and during tests. O&M data shall be available to Engineer at site both before and during testing.

.6 Determination of Ready for Operation: When Functional Test has been completed

3.5 Customer Training

3.5.1 Provide Instrumentation training in accordance with Section 13100 – Control and Instrumentation and Section 01820 Demonstration and Training.

3.6 Forms

3.6.1 Complete an Instrumentation Installation Checklist Form and Instrumentation Calibration Form for each instrument that is tested and commissioned.

3.6.2 Refer to forms listed below. Each instrument shall include the following supplement forms filled out, reviewed, and approved.

.1 Instrumentation Installation Checklist.

.2 Instrumentation Calibration Form.

.3 System Problem Report Form: Use this form to record information about problems that are found during testing of Computer Subsystems, Distributed Control Subsystems, and Telemetry Subsystems.

.4 I&C Valve Adjustment Sheet: Each sheet shows detailed information for installation, adjustment, and calibration of a given valve.

.5 Performance Test Sheet: Describes the Performance Test for a given loop. The format is mostly free form.

.1 Lists the requirements of the loop.

.2 Briefly describes the test.

.3 Cites expedited results.

.4 Provides space for checkoff by witness.

.6 I/O Test Report: Shows dates that wiring test was successfully performed.

.7 Compliance Form

Instrumentation Installation Checklist

Project Name:	Project Number:	
Contractor:	Contract Number:	

EQUIPMENT:	**DATE INSTALLATION COMPLETE:**
SERIAL NO.:	**MAKE AND MODEL NO.:**

PRE-START-UP	CHECKED BY	DATE	REMARKS
Installation/Mounting Sensor/Transmitter			
Wiring/Conduit Termination and Seals			
Check Fuse Ratings (Internal)			
Tagging/Nameplate			
Compliance Section 16			
Test (Ground Loop, Continuity, Installation)			
Power Supply			
Check Instrument Air/Adjust Filter/Regulator			
Check Temp. Control (Internal/Heat Tracing)			
Configure Calibration			
Tailback lights			

START-UP Verify Operation Under Max Process Conditions			
Correct Quantities of Expandable Material			
* Indicates (N/A) if not applicable			
Comments:			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor

Supplier Date

Date

System Integrator

Date

Consultant

Date

City/Operator

Date

Instrumentation Calibration Form

Project Name:	Project Number:	
Contractor:	Contract Number:	

Equipment:	
Tag/Instrument Number:	
PLC:	
Input Point:	
Manufacturer:	
Model Number:	
Serial Number:	
Calibration Range:	

Service			
Temperature		Chlorine Residual	
Pressure		pH	N/A
Differential Pressure	N/A	Density	N/A
Flow		Dissolved Oxygen	N/A
Level		Gas monitoring	N/A
Weight	N/A	Others	

Type			
4-20 mA		0-100 VDC	N/A
0-20 mA	N/A	Digital Input	
1-5 VDC	N/A		

Power Source			
120 VAC		Dry Contact	Not Required
24 VDC			

Test Full Range			
0 %		75 %	
25%		100 %	
50 %			
On/Off (Digital)			
Verification			
Contractor			
Consultant			
City			
Date			
Comments			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	

Contractor _____ Date _____

Supplier _____ Date _____

System Integrator _____ Date _____

Consultant _____ Date _____

City/Operator _____ Date _____

END OF SECTION

1 GENERAL

1.1 Intent of Section

1.1.1 This section covers the work necessary to provide the pH Analyzer (with sensor) for raw water sampling.

1.2 Related Sections

1.2.1 DIVISION 1 – GENERAL REQUIREMENTS

1.2.2 DIVISION 11 – EQUIPMENT

1.2.3 DIVISION 13 – INSTRUMENTATION, CONTROL AND SCADA

1.2.4 DIVISION 16 – ELECTRICAL

1.3 GENERAL

1.3.1 Equipment provided under this section shall be fabricated, assembled, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, manufacturer's instructions unless exceptions are noted by the Engineer.

.1 Equipment and services provided under this section shall be subject to the requirements specified in Section 13100 – Control & Instrumentation and Section 13560 – Instrumentation General Requirements. This section shall be used and referenced only in conjunction with Section 13560 – Instrumentation General Requirements. Supplementing Section 13560 – Instrumentation General Requirements, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule. Equipment and services in this section shall be provided by the Section 13100 – Control & Instrumentation.

.2 Section 13100 – Control & Instrumentation shall apply to all systems described in this section. All applicable requirements defined in Section 13100 – Control & Instrumentation shall apply to equipment and services provided under Section 13560 – Instrumentation General Requirements.

1.4 SUBMITTALS

1.4.1 In accordance with Section 01330 - Submittals.

1.4.2 Complete detailed specifications, and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section.

1.4.3 Detailed information regarding the dissolved oxygen meter shall be provided for record purposes, including materials, methods of application, maintenance requirements, and other pertinent data.

1.4.4 Operations and Maintenance Procedures and Manuals shall be provided including, but not limited to calibration certificates and materials testing reports.

2 PRODUCTS

2.1 SERVICE CONDITIONS

2.1.1 Process Description: The pH analyzer shall be used to monitor the pH level of raw water from Lake Huron collected by the intake sampling line.

2.1.2 One (1) pH analyzer shall be required.

2.1.3 The pH sensor shall be installed on 25 mm (1”) PVC pipes.

2.2 DESIGN REQUIREMENTS

2.2.1 General Requirements. The work includes the supply, delivery, supervision of the installation, commissioning and training in the use and maintenance of pH analyzers:

Analyzer	Sensor	Location
One (1) analyzer	One (1) pH Sensor	Raw water discharge line, LLPS

2.2.2 Operating pH range shall be 6 to 9.

2.2.3 Operating flow rate shall be in the range of 0 to 60 L/min at 15 psi of pressure in the sampling line. The flow rate and pressure shall be confirmed by the Contractor when the sampling pump is selected.

2.2.4 Refer to the instrument datasheet and Contract Drawings for location of sensor and transmitter.

2.3 FABRICATION

2.3.1 Suitable surface preparations should be applied to components during manufacturing of the product.

2.3.2 It is the manufacturer’s sole responsibility to maintain the highest quality standards and controls of its product.

2.3.3 All welded parts shall be free of contaminants. Similar materials must be used as filler materials.

2.4 MULTI CHANNEL ANALYZER

2.4.1 pH analyzer shall be supplied complete with monitor, sensor, insertion hardware, custom connectors, cables.

2.4.2 The monitor shall be housed in a NEMA 4X enclosure with brackets suitable for backplate mounting.

2.4.3 Equipment shall be designed and constructed to meet the following requirements.

.1 The Sensor Transmitter shall be housed in a fiberglass (or polycarbonate) NEMA 4X enclosure with brackets for wall or standard round handrail mounting. It will be connected to the sensor via an integrated, shielded, four wire (or CYK10 memosens) cable supplied with the sensor.

.2 Display shall be graphic dot matric LCD with LED backlighting, trans-reflective or color, backlit, 320 W x 240H pixels

.3 Flash memory or built In Memory with USB port which allow to download data (upto 520,000 measurement points including configuration, calibration history and fault/error) on USB drive without any need of cable or software.

.4 Power requirements are 120 VAC, 50/60 Hz

.5 Operating temperature: -20°C to 60°C

.6 Output: 4–20mA with HART communication

.7 Provide a programmable relay dry contact, rated 15A 120VAC –, for use as a setpoint or alarm.

2.5 SensorS

2.5.1 The Contractor shall confirm the pipe size. It is assumed that the pipe diameter is 25 mm.

2.5.2 The sensor shall be installed on the pipe with insertion hardware. The Supplier shall provide the insertion detail. A minimum requirement for the insertion shall be as follows:

.1 25 mm ball valve or suitable size

.2 25 mm NPT close nipple

.3 Sensor adaptor with two (2) Viton O-ring and wiper, extension pipe, pipe adaptor, back tube and lock ring

2.5.3 Sensor type may be either digital or analog.

2.5.4 Measuring range: 5 to 10 pH

2.5.5 Sensitivity: ± 0.01 pH

2.5.6 Stability: 0.03 pH per 24 hours

2.5.7 Sensor pressure limit: 100 psi at 100°C

2.5.8 NTC 300-ohm thermistor for automatic temperature compensation and analyzer temperature readout.

2.5.9 Sensor cable: 4 conductor cables with one shied and polyurethane jacket.

2.5.10 Wetted material: PEEK, salt bridge of matching material with Kynar junction, glass process electrode, titanium ground electrode, and Viton O-ring seals. Sensor material may be glass and Teflon with insertion hardware 316L SS.

2.5.11 Provide an analog junction box if required. Cable length shall be a minimum of 15m, but the Contractor and Supplier shall confirm the required length at the site. No extra cost to the Owner shall be permitted for the junction box and longer cable.

2.6 ACCEPTABLE MANUFACTURERS

2.6.1 The below Supplier list shall not be construed as automatically acceptable, but the Owner or Engineer shall have the right, in its sole and absolute discretion, to accept or reject the shop drawing if the Supplier selected by the Contractor does not comply with the Contract Drawings and specification requirements herein.

ProMinent, Hach, Endress+Hauser or Approved Equal.

2.7 WARRANTY

.1 The analyzers and sensors shall be warranted against defects in workmanship and materials for five (5) years from the date of installation.

.2 Shop testing shall be performed to ensure the meters are free of defective parts, cracks, or any other defects.

.3 Unit shall be pre-calibrated at the factory. A copy of the factory calibration report shall be provided to the Owner.

3 EXECUTION

3.1 INSTALLATION

3.1.1 The meter shall be installed in accordance with the manufacturer's drawings, recommendations, and instructions.

3.1.2 The layout of the analyzer and sensing assemblies is detailed on the contract drawings.

3.2 FIELD QUALITY CONTROL

3.2.1 Installation Check: The pH analyzer manufacturer shall provide the services of a qualified field representative according to the quality control section to assist during installation of the equipment by the Contractor. As a minimum, the manufacturer's field representative shall be made available for each OCF as follows:

.1 Installation Inspection 1 trip, 0.5 day total

.2 Startup assistance 1 trip, 0.5 day total

3.2.2 Field Evaluation Tests. A performance test shall be run on the meter after the installation is completed. The meter readings shall be compared to a fully calibrated, primary lab handheld meter reading over a four (4) hour period. Consistent average deviations of more than 1 % reading between the handheld meter and the installed meter will be considered unacceptable. Modifications and/or retesting shall be performed until satisfactory readings are maintained. The performance test shall be conducted by a capable representative of the manufacturer and accepted by the Engineer. The Owner's operating personnel shall assist the manufacturer's representative in the performance test. A designated representative of the Owner and/or the Engineer shall observe the performance test. As a minimum, the

manufacturer's field representative shall be made available for each tank meter assemblies as follows:

.1 Performance testing 1 trip, 0.5 day total

3.2.3 At least two (2) weeks prior to the proposed testing date, the Contractor shall notify the Engineer of the testing date and shall submit a report from the equipment manufacturer detailing the proposed performance testing procedure and analyses. Testing shall be performed between 8:00 a.m. and 5:00 p.m. and shall begin on Monday or Tuesday. If more than one (1) day of testing is required, the testing shall be done on consecutive days. The Engineer's initial observation of tests shall be at the Owner's expense. All costs of subsequent visits by the Engineer to witness or observe additional tests necessary because of failure of the initial tests or inability to conduct the initial tests will be deducted from monies owed to the Contractor.

3.2.4 Should the equipment not achieve consistent compliance during the tests, then the manufacturer shall modify the equipment and repeat the field evaluation tests. Costs of modifying equipment, reducing or furnishing additional equipment, shall be borne by the manufacturer. Additional equipment shall include all items specified or indicated, or required to be part of a complete functional system. Should the equipment fail to meet all the design requirements after retesting, the equipment shall be rejected and shall be replaced by the Construction Contractor with acceptable equipment at no additional cost to the Owner.

3.2.5 Performance Test and Field Evaluation Report. The meter assembly manufacturer shall prepare a formal test report, including all measured data and other recorded data and observations. The report shall be submitted to the Engineer within 30 days after completion of the tests.

END OF SECTION

1 GENERAL

1.1 Related Sections

1.1.1 DIVISION 1 – GENERAL REQUIREMENTS

1.1.2 Section 13100 – Control & Instrumentation

1.1.3 Section 13560 – Instrumentation General Requirements

1.1.4 DIVISION 16 – ELECTRICAL

1.2 SCOPE

1.2.1 This section covers the furnishing of all pressure and level instruments and accessories required for the Control and Instrumentation System as indicated on the drawings.

1.2.2 Equipment and services provided under this section shall be subject to the requirements specified in Section 13100 – Control & Instrumentation and Section 13560 – Instrumentation General Requirements. This section shall be used and referenced only in conjunction with Section 13560 – Instrumentation General Requirements. Supplementing Section 13560 – Instrumentation General Requirements, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule. Equipment and services in this section shall be provided by the Section 13100 – Control & Instrumentation.

1.2.3 Section 13100 – Control & Instrumentation shall apply to all systems described in this section. All applicable requirements defined in Section 13100 – Control & Instrumentation shall apply to equipment and services provided under Section 13560 – Instrumentation General Requirements.

1.3 DESIGN CRITERIA

1.3.1 Each device shall be a pre-assembled, packaged unit. Upon delivery to the work site, each device or system shall be ready for installation with only minor piping and electrical connections required by the Contractor.

1.3.2 Primary elements shall derive any required power from the transmitter, unless otherwise indicated.

1.3.3 The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the drawings or as indicated in the Instrument Device Schedule. The instruments shall be installed at the locations indicated on the drawings or in the Instrument Device Schedule. Where possible, each instrument shall be factory calibrated to the calibration ranges indicated in the drawings or in the Instrument Device Schedule. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. For "smart" devices, calibration data shall be stored digitally in each device, including the instrument tag designation indicated on the drawings and/or Instrument Device Schedule.

1.4 SUBMITTALS

1.4.1 Submittals shall be made in accordance with the requirements of Section 01330 – Submittals.

1.5 SHIPMENT, PROTECTION AND STORAGE

1.5.1 Equipment provided under this section shall be shipped, protected, and stored in accordance with the requirements of Section 13560 – Instrumentation General Requirements. Identification of packaging shall be as described in Section 13560 – Instrumentation General Requirements.

2 PRODUCTS

2.1 GENERAL

2.1.1 The following paragraphs provide minimum device requirements. The drawings or Instrument Device Schedule shall be used to determine any additional instrument options, requirements, or service conditions.

2.1.2 Interconnecting Cable. For systems where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be a minimum of three meters or as indicated in the drawings or Instrument Device Schedule.

2.1.3 Programming Device. For systems that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for the Blind River LLPS. The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device:

.1 The programming device shall be complete, newly purchased for this project, and shall be in like-new condition when turned over to Owner at completion of start-up.

2.1.4 Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. As a minimum, an appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each Owner facility. Software shall be capable of running under Microsoft's Windows 2000, Windows 98/Me, Windows NT 4.0, and Windows XP operating system. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.All instruments to be installed in a classified area shall be explosion proof (Class I, Division 1).

2.2 PRESSURE INSTRUMENTATION

2.2.1 Pressure Transmitters

.1 Transmitters shall have electronic circuitry and shall be of the two-wire type. Process fluid shall be isolated from the sensing elements by AISI Type 316 stainless steel, and the transducer may use a silicone oil fluid fill. Transmitters shall have self-diagnostics and electronically adjustable span, zero, and damping. Transmitters shall be enclosed in a NEMA Type 4X housing. Where transmitters are installed in Class 1, Division 1 environments, the transmitter shall be certified for such areas. Transmitters shall meet the following performance/operation conditions:

.2 All parts shall be cadmium plated carbon steel, stainless steel, or other corrosion-resistant materials. Process flanges, adapters, isolating diaphragm, drain and vent valves shall be 316 stainless steel for all applications, except for Sodium Hypochlorite application. For Sodium Hypochlorite application, Hasteloy C-276 shall be used. For Transmitters shall have over-range protection to maximum line pressure. Transmitter output shall be 4-20 mA DCwithout the need for external load adjustment. Transmitters shall not be damaged by reverse polarity. Transmitters shall have an elevated or suppressed zero as required by the application. For calibrated spans of less than 55 kPa gauge a differential pressure type transmitter with side vents shall be utilized. Transmitters shall be provided with brackets for wall mounting or pipe-stand mounting.

.3 Transmitters shall be factory calibrated to the required range and provided with the manufacturer's standard handheld communications/calibration device. One hand-held communications device shall be furnished for every ten transmitters provided by a single manufacturer. Minimum of one and maximum of four hand-held communications devices shall be furnished. The transmitter may be configured locally through buttons, easily accessible without opening the cover of the pressure transmitter, and remotely via HART communication using a handheld (e.g., FC475) or PC software such as SIMATIC PDM.

.4 Transmitters tagged on the drawings or specified to be indicating type shall be furnished with LCD type digital indicators.

.5 Seals, when indicated in Device Schedule, shall be standard equipment from the primary element supplier. Pancake or flanged seals as required to suit the process connections shall be provided. Seals shall be 316 stainless steel housing, S.S. diaphragm material, Teflon coated, 50mm process connection unless noted otherwise, 6mm flushing connection in bottom housing, DC 200 fill fluid, 1.75 mm PVC coated armored capillary minimum 4 meters length, rated from vacuum to 2500 psig and -40º to 200ºC, continuous duty. Hasteloy C-276 diaphragm material shall be used for Sodium Hypochlorite application.

.6 Wetted O-rings shall be Viton, Glass Filled TFE, or Graphite Filled PTFE

.7 Cover O-rings shall be Buna-N.

.8 Electrical connections shall be ½” -14 NPT weatherproof conduit

.9 Process connections shall be ¼” 18 NPT on flanges, ½” NPT on adapters.

.10 Transmitter shall allow over-pressure/under-pressure alarms to drive signal to high or low full scale (selectable).

.11 Transmitter shall allow failure mode alarm to drive analog signal to high or low full scale (selectable).

.12 Transmitter shall have internal security switch preventing unauthorized changes to calibrated configuration.

.13 Transmitter shall have adjustable damping 0 to 16 seconds.

.14 Transmitter shall be powered with 24VDC.

.15 Acceptable Suppliers

.1 The below Supplier list shall not be construed as automatically acceptable, but the Owner or Engineer shall have the right, in its sole and absolute discretion, to accept or reject the shop drawing if the Supplier selected by the Contractor does not comply with the Contract Drawings and specification requirements herein.

.2 Rosemount, Siemens,

.3 Endress+Hauser

.4 Or Approved Equal

2.2.2 Pressure Gauges:

.1 The Contractor and Supplier shall confirm the required pressure range for each pressure gauge based on the pressure in the lines. No extra cost to the Owner shall be permitted for the Engineer to determine the range. Refer to the discharge pressure of the pumps, fans and blowers.

.2 Supply and install pressure gauges size and location as shown on the Contract Drawings and/or specified herein.

.3 Pressure gauges shall be 114 mm dial size with fiberglass reinforced polypropylene case, threaded ring, solid front, blow out back, molded acrylic window.

.4 Movement shall be stainless steel.

.5 Bourdon tube shall be bronze.

.6 Dial face shall be white with black figures, pointer shall be micrometer adjustable type.

.7 Dual scale and operating range 0 to be suitable to design range specified.

.8 Pressure gauges shall be liquid filled.

.9 All pressure gauges shall be supplied with a Campbell Microbeam isolating dampening valve.

.10 Each pressure gauge shall be furnished with a flow-through annular seal which is of stainless steel 316L.

.11 Acceptable Suppliers:

.1 Trerice Type 450 LFB, Ashcroft Durogauges Type 1279 ASL, or Agency Approved Equal

2.3 LEVEL INSTRUMENTATION

2.3.1 Ultrasonic Level Transmitters

.1 Each ultrasonic level transmitter shall be a microprocessor based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and an interconnecting cable. The sensor shall be encapsulated in a chemical and corrosion resistant material such as kynar or CPVC and shall be suitable for operation over a temperature range of -40° to 80°C and a relative humidity of 100% condensing. The sensor shall be

compatible with the process media being measured. Sensors mounted in direct sunlight shall be provided with sunshades.

.2 The supplier shall coordinate the sensor mounting requirements and furnish drawings complete with dimensions and elevations. General installation requirements are indicated on the drawings.

.3 The ultrasonic level transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probes are provided, they shall be mounted with or adjacent to the ultrasonic sensor, as recommended by the manufacturer. The transmitter shall have a local backlit HMI display with local four-button programming, which displays level in engineering units, with additional indicators for alarms and status conditions. The transmitter shall be designed to ignore momentary level spikes, false targets, or momentary loss of echo.

.4 A loss of echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output. The loss-of-echo alarm shall fail to “Hold Last State” position after five minutes. The transmitter output shall be an isolated 4 – 20 mA dc signal linearly proportional to the measured level range. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory.

.5 Transmitters shall have Microsoft windows based graphical programming software. and Local User Interface for echo profile viewing and troubleshooting. The transmitter can accept 4-20 mA input from external device instead of the transducer input. Accuracy of the transmitted signal shall be +/-0.25 percent of measuring Range with repeatability of +/- 0.5 percent of full scale and linearity of +/-0.25 percent of full scale.

.6 Transmitters shall contain four independently adjustable level alarm contact outputs. Contacts shall be single-pole, double-throw rated not less than 5 amperes at 120VAC.

.7 A sufficient length of sensor to transmitter signal cable shall be furnished with the instrument to locate the sensor 7.6 to 365 m from the signal converter.

.8 the signal converter electronics is housed in a weatherproof, corrosion resistant NEMA4X, IP65 enclosure suitable for wall, panel or pipestand mounting and for operating temperatures of -20 to +50 °C (-4 to +122 °F) and a relative humidity of 10 to 100 percent. A thermostatically controlled strip heater shall be provided in the signal converter enclosure.

.9 Where sensors are installed in Class 1, Division 1 or 2 environments, the sensors shall be certified for such areas. Transmitters may be installed in electrical room if need be. Refer to Instrument Schedule for Classification Requirements.

.10 Transmitters to include HART communication.

.11 The Contractor and Instrument Supplier shall confirm the transducer (sensor) locations and provide the extended rod if required. No extra cost shall be permitted for the extended rods.

.12 Acceptable Suppliers:

.1 The below Supplier list shall not be construed as automatically acceptable, but the Owner or Engineer shall have the right, in its sole and absolute discretion, to accept

or reject the shop drawing if the Supplier selected by the Contractor does not comply with the Contract Drawings and specification requirements herein.

.2 Siemens LUT400 complete with XPS 15 transducer,

.3 Endress+Hauser

.4 or Approved Equal

2.3.2 Adjustable Deadband Float Type Level Switch.

.1 Level switches shall consist of a non-mercury type switch element encapsulated in a nominal 127mm diameter PVC float housing. The switch contact shall be single-pole, double-throw, rated 10 amp at 120 V AC. The float shall be supported from a flexible three-conductor 18 AWG cable that also acts as the float hinge. The cable shall be suitable for fixed mount or weighted suspension type installation as indicated on the drawings or in the Instrument Device Schedule. All necessary mounting hardware shall be provided. The hinge-cable length shall be field adjustable in a manner that allows the deadband to be adjusted between 229mm and 0.91m. Sway control rings, hanger brackets, and local junction boxes are to be included:

.2 Acceptable Product: Flygt “ENM-10” or Agency Approved Equal.

2.3.3 Flood Level Switches.

.1 The flood detecting level switches shall be float actuated and shall be suitable for wall or sump mounting as required. The switch float mechanism shall actuate when the water level rises to 25mm above the bottom of the housing. The switch contacts shall be hermetically sealed, rated for 0.1 amp at 120VAC, and shall be field changeable from normally open to normally closed. Sway control rings, hanger brackets, and local junction boxes are to be included:

.2 Acceptable Product: Flygt “ENM-10”.

3 EXECUTION

3.1 Warranty

3.1.1 The analyzers and sensors shall be warranted against defects in workmanship and materials for five (5) years from the date of installation.

3.1.2 Shop testing shall be performed to ensure the meters are free of defective parts, cracks or any other defects.

3.1.3 Unit shall be pre-calibrated at the factory. A copy of the factory calibration report shall be provided to the Owner.

3.2 Field services

3.2.1 Manufacturer’s field services shall be provided for installation, field calibration, startup, and training as specified in Sections 13100 – Control & Instrumentation and 13560 – Instrumentation General Requirements.

3.2.2 Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. CSS shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of common construction or cleaning chemicals that may affect instrument operation.

END OF SECTION

1 GENERAL

1.1 Related Sections

1.1.1 Section 01330 - Submittals

1.1.2 Section 01820 – Demonstration and Training

1.1.3 Section 13100 – Control & Instrumentation

1.1.4 Section 13560 – Instrumentation General Requirements

1.2 Scope

1.2.1 This section covers the furnishing of all miscellaneous instruments and accessories required for the Control & Instrumentation System as indicated on the drawings and on the Instrument Device Schedule.

1.2.2 Equipment and services provided under this section shall be subject to the requirements specified in Section 13100 – Control & Instrumentation and Section 13560 – Instrumentation General Requirements. This section shall be used and referenced only in conjunction with Section 13560 – Instrumentation General Requirements. Supplementing Section 13560 – Instrumentation General Requirements, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule. Equipment and services in this section shall be provided by the Section 13100 – Control & Instrumentation.

1.2.3 Section 13100 – Control & Instrumentation shall apply to all systems described in this section. All applicable requirements defined in Section 13100 – Control & Instrumentation shall apply to equipment and services provided under Section 13560 – Instrumentation General Requirements.

1.3 Design Criteria

1.3.1 Each device shall be a pre-assembled, packaged unit. Upon delivery to the work site, each device or system shall be ready for installation with only minor piping and electrical connections required by CSS.

1.3.2 Primary elements shall derive required power from the transmitter, unless otherwise indicated.

1.3.3 The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the drawings. The instruments shall be installed at the locations indicated shown on the drawings.

1.3.4 Where possible, each instrument shall be factory calibrated to the calibration ranges indicated on the drawings. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. For "smart" devices, calibration data shall be stored digitally in each device, including the instrument tag designation indicated on the P&I diagram.

1.4 Submittals

1.4.1 Submittals shall be made in accordance with the requirements of Section 01330 – Submittals.

1.5 Shipment, Protection, and Storage

1.5.1 Equipment provided under this section shall be shipped, protected, and stored in accordance with the requirements of Section 13100 – Control & Instrumentation. Identification of packaging shall be as described in Section 13100 – Control & Instrumentation.

2 PRODUCTS

2.1 General

2.1.1 The following paragraphs provide minimum device requirements. The drawings shall be used to determine additional instrument options, requirements, or service conditions.

2.1.2 Interconnecting Cable. For systems where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be a minimum of three meters or as indicated on the drawings.

2.1.3 Programming Device. For systems that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each Owner facility. The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device:

.1 The programming device shall be complete, newly purchased for this project, and shall be in like-new condition when turned over to Owner at completion of startup.

.2 Provide the following equivalent: one (minimum) smart instrument calibration device for every ten (10) smart instruments, TREX L H P KL W S3S Wireless and Bench Calibration by Rosemount..

2.1.4 Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. As a minimum, an appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each Owner facility. Software shall run under Microsoft's Windows 7 and Windows XP operating systems. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

2.1.5 Instrument/Equipment Tagging: All new instruments tied to the new ICP are to include new lamacoids with the new tagging in accordance with the latest Town of Blind River SCADA tagging convention.

2.2 Miscellaneous Instruments

2.2.1 Provide new field wiring and conduits to all new and existing building services to the new ICP, including but not limited to temperature switches, temperature transmitters, smoke detectors, etc. Contractor to investigate and locate the exact locations of all existing equipment on site.

2.2.2 Resistance Temperature Detectors. Each temperature detector shall be a nominal 100 ohm, three wire, hermetically sealed, platinum resistance element. The sensing element shall be enclosed in an AISI Type 316 stainless steel outer sheath. Accuracy shall be ±0.6°C over the specified operating range. Temperature detectors shall be assembled as per ANSI (ISA) 96.1 standard. Insulation shall be provided between leads and the probe housing using ceramic oxide insulation:

.1 A stainless steel thermowell shall be provided for each element. The thermowell shall be a thread mounted style with a 25mm (one inch) NPT process mounting thread. The approximate process insertion length of the thermowell shall be approximately 1/3 pipe diameter immersion depth plus 75mm (three inch) extension. The temperature element shall be spring-loaded in the thermowell. Appropriate temperature head hardware shall be provided with the assembly.

2.2.3 Low Room Temperature Switch – TSL:

.1 Honeywell Thermostat T631 complete with locking cover.

.2 Temperature Range: 7°C to 28°C

.3 Fixed Differential: 1°C

.4 Contact rating 3.0A, 120VAC

.5 Each temperature switch is to be powered from the ICP on its own respective fuse. A high temperature alarm for each switch shall be tied to the ICP for monitoring. Provide additional relays as required to provide a 120VAC low temperature alarm to the ICP.

.6 CSA approved

2.2.4 High Room Temperature Switch – TSH:

.1 Honeywell Thermostat Model Farmostat complete with locking cover.

.2 Temperature Range: -10°C to 40°C

.3 Fixed Differential: 1°C

.4 Contact rating 3.0A, 120VAC

.5 Each temperature switch is to be powered from the ICP on its own respective fuse. A high temperature alarm for each switch shall be tied to the ICP for monitoring. Provide additional relays as required to provide a 120VAC low temperature alarm to the ICP.

2.2.5 Temperature Gauges. Temperature gauges shall meet the following performance:

Accuracy:	+/- 1 percent of span
Range Limits:	0 to 100°C or as required by the process
Repeatability:	+/-1.0 percent

.1 Temperature gauges shall be of the indicating dial type, with a stainless-steel bimetal thermometer and a stainless steel thermowell; stainless steel rotary geared movement; phenolic or polypropylene open front turret case; adjustable pointer; stainless steel, phenolic, or polypropylene ring; and acrylic plastic or shatterproof glass window.

.2 Gauge dial shall be 114 mm size, with white background and black markings. The units of measurement shall be indicated on the dial face. Subdivisions of the scale shall conform to the requirements of the governing standard. Pointer travel shall be not less than 200 degrees or more than 270 degrees of arc. The displayable temperature range shall exceed the greatest of the 125 percent of the maximum possible system temperature and 200 percent of the normal working temperature.

.3 Panel-mounted and surface-mounted gauges shall be provided with 6mm NPT connections. All stem-mounted gauges shall be provided with 12mm NPT connections. Where indicated on the drawings or the Instrument Device Schedule, stem mounted gauges shall have an adjustable viewing angle to allow the gauge to be positioned for optimum viewing.

.4 All temperature gauges shall measure in degrees Celsius. All gauges shall have a suitable range to give mid-scale readings under normal conditions. Gauge accuracy shall be one percent of scale range.

.5 Each gauge shall be provided with a thermowell. Unless otherwise indicated in the drawings or Instrument Device Schedule, thermowells shall be weld mount style. Thermowell materials shall be compatible with the process fluid. Where the process fluid is not defined, thermowells shall be AISI Type 316 stainless steel.

.6 Gauges shall be installed at the locations indicated on the drawings, with installation conforming to the installation standards. All gauges shall be installed in the vertical, upright position. Thread sealer, suitable for use with the associated process, shall be used in the assembly of threaded connections. All connections shall be free from leaks. Lines shall be purged of trapped air at gauge locations prior to installation.

.7 Each gauge shall be provided with all required mounting hardware to securely mount the unit according to the mounting requirements indicated on the drawings or the Instrument Device Schedule.

.8 Unless otherwise indicated, mounting and installation hardware shall be AISI Type 316L stainless steel.

.9 Temperature gauges shall be Ashcroft “50 Series” or Rosemount or Weiss Instruments approved equivalent product.

2.2.6 Smoke Detectors:

.1 Power Supply: 120VAC or 24VDC source from control panel UPS.

.2 ULC Listed

.3 Contact rating 3.0A, 120VAC

.4 Each smoke detector is to be powered from the ICP on its own respective fuse. A smoke alarm for each smoke detector shall be tied to the ICP for monitoring. Provide additional relays as required to provide a 120VAC smoke alarm to the ICP.

.5 Acceptable Product: Edwards or Approved Equivalent.

2.2.7 Field Mounted Process Indicators. Field-mounted process indicators that are not integral with the transmitter shall be of the two-wire type that accepts a 4 20 mA dc input and does not require a direct power source connection. Indicators shall have corrosion resistant, weatherproof housings and shall be suitable for operating over an ambient temperature range of 10° to +55°C. Indicators shall read in engineering units. A nameplate that describes the indicator service function and the scale units shall be provided on the indicator:

.1 Indicators shall be of the digital display type with an accuracy of 0.1 percent. The display shall be 3 1/2-digit LCD type, with a digit height of not less than 12.7mm and with a selectable decimal point. Indicators shall be Action Instruments "Series V560", Rosemount “Model 751”, or Precision-Digital "Model PD686".

2.2.8 Instrument Shutoff Valves. Instrument shutoff valves shall be provided for all instruments to suit calibration and isolation and as detailed in the specifications. The indicated shutoff valves shall be provided by CSS for all instruments furnished under Sections 13560 thru 13565. Shutoff valves shall be compatible with the measured process and shall be selected in accordance with the manufacturer’s recommendations for the specified process. Unused ports of multi-port gauge valves shall be plugged. An instrument shutoff valve schedule shall be submitted indicating the quantity, material, size, and associated instrument. Permanent tagging of the instrument valves is not required. However, temporary hand-written tags or other means of identification shall be provided to ensure that the appropriate valve is installed for a given instrument:

.1 Instrument shutoff valves shall be D/A Manufacturing, Anderson-Greenwood, or equal.

2.2.9 Flow Switches:

.1 Process equipment vendor is to provide a flow switch for each respective system based on the vendor recommendations. The flow switch is to include the following as a minimum:

.1 120VAC, 5-amp DPDT Control Relay.

.2 Ambient operating temperature: -20°C to + 60°C.

.3 Trigger setpoints are to be provided by the vendor.

.4 Approved manufacturers:

.1 Pulsar Measurement: DFS-II Doppler Flow Switch, or Agency Approved Equal

.2 The flow switch electronics shall be enclosed in a NEMA Type 4X /IP 66 rated housing and shall operate at process temperatures and ambient temperatures that satisfy specifications

3 EXECUTION

3.1 Field Services

3.1.1 Manufacturer's field services shall be provided for installation, field calibration, start-up, and training as specified in Sections 13100 – Control & Instrumentation, 13560 – Instrumentation General Requirements, and 01820 – Demonstration and Training.

3.1.2 Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. The CSS shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of common construction or cleaning chemicals that may affect instrument operation.

END OF SECTION

1 GENERAL

1.1 Related Sections

1.1.1 Section 01820 – Demonstration and Training

1.1.2 Section 13100 – Control & Instrumentation

1.1.3 Section 13560 – Instrumentation General Requirements

1.2 Scope

1.2.1 This section covers the furnishing of all temperature and turbidity instruments and accessories required for the Control & Instrumentation System as indicated on the drawings and on the Instrument Device Schedule.

1.2.2 Equipment and services provided under this section shall be subject to the General Instrumentation Requirements specified in Section 13100 and Section 13560. This section shall be used and referenced only in conjunction with Section 13560. Supplementing Section 13560, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule.

1.2.3 Section 13100 shall apply to all systems described in this section. All applicable requirements defined in Section 13100 shall apply to equipment and services provided under Section 13560.

1.2.4 The Contractor shall install the instruments on the locations as shown on the Contract Drawings and provide all signal and power cables. If the cables are not presented on the Contract Drawings, the Contractor shall coordinate with the Engineer, the installation location, but no extra cost of the installation is allowed.

1.3 Design Criteria

1.3.1 Instrumentation is to be wired in the manner shown in the Instrumentation Loop Drawings in the Contract Drawings set and Specs. In the event of a wiring discrepancy between the instrumentation and the Contract Drawings, the Contractor is to ask the Engineer for Direction.

1.3.2 Each device shall be a pre-assembled, packaged unit. Upon delivery to the work site, each device or system shall be ready for installation with only minor piping and electrical connections required by CSS.

1.3.3 Primary elements shall derive required power from the transmitter, unless otherwise indicated.

1.3.4 The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the drawings. The instruments shall be installed at the locations indicated shown on the drawings.

1.3.5 Where possible, each instrument shall be factory calibrated to the calibration ranges indicated on the drawings. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. For "smart"

devices, calibration data shall be stored digitally in each device, including the instrument tag designation indicated on the P&I diagram.

1.4 Submittals

1.4.1 Submittals shall be made in accordance with the requirements of Section 13100.

1.5 Shipment, Protection, and Storage

1.5.1 Equipment provided under this section shall be shipped, protected, and stored in accordance with the requirements of Section 13100. Identification of packaging shall be as described in Section 13100.

2 PRODUCTS

2.1 General

2.1.1 The following paragraphs provide minimum device requirements. The drawings shall be used to determine additional instrument options, requirements, or service conditions.

2.1.2 Interconnecting Cable. For systems where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be a minimum of three meters or as indicated on the drawings.

2.1.3 Programming Device. For systems that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each Owner facility. The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

2.1.4 The programming device shall be complete, newly purchased for this project, and shall be in like-new condition when turned over to Owner at completion of startup.

2.1.5 Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. As a minimum, an appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each Owner facility. Software shall run under Microsoft's Windows 7 and Windows XP operating systems. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

2.2 Water Temperature Transmitter and Probe

2.2.1 Unit must have an LCD/button interface for displays status and for configuring it.

2.2.2 Unit shall have stainless steel wetted parts.

2.2.3 Version with all mounted transmitter and RTD probe on cable "WIKA-ATS-18732 SH1"

2.2.4 Version with RTD probe and transmitter together: " WIKA TR50-U9-I-ZZ-1XP1-B1FZZZ-CBC-03000"

2.2.5 Inserts into process via isolating ball valve and compression fitting

2.2.6 Transmitter power supply shall be powered with 24VDC.

2.2.7 Acceptable Product: WIKA TR10 probe with WIKA TR32 transmitter and WIKA DIH50 display, TW45 thermowell and isolation ball valve.

2.3 Turbidity Analyzer.

2.3.1 Work includes supply, delivery, installation, commissioning and training for all turbidity analyzers, as shown on the contract drawings and as specified herein.

2.3.2 The turbidity analyzer shall conform to the following specifications:

.1 The turbidity analyzer shall be a microprocessor-based, continuous-reading, on-line nephelometric instrument.

.2 The turbidity monitoring system shall include one or two turbidity analyzer(s) and one interface unit.

.3 The turbidity analyzer shall measure turbidity in the range of 0.001-100 NTU.

.4 Accuracy shall be ±2% of reading or ±0.015 NTU (whichever is greater) from 0 to 40 NTU; ±5% of reading from 40 to 100 NTU.

.5 Displayed resolution shall be 0.0001 NTU from 0 to 9.999 NTU and 0.001 NTU from 10.000 to 9.999 NTU.

.6 Repeatability shall be better than ±1.0% of reading or ±0.002 NTU (whichever is greater).

.7 The turbidity analyzer shall meet all design and performance criteria specified by USEPA method 180.1.

.8 Light shall be directed through the surface of the sample and the detector shall be immersed in the sample, eliminating glass windows and flow cells.

.9 Optical components shall be mounted in a sealed head assembly that can be removed for calibration/ service without disturbing sample flow.

.10 The turbidity analyzer body shall be constructed of corrosion-resistant polystyrene.

.11 An internal bubble removal system shall be included to vent entrained air from the sample stream.

.12 Calibration of the turbidity analyzer shall be either formazin-based (20 or 1 NTU) or instrument comparison-based calibration method.

.13 User selectable signal averaging, bubble removal, alarm and recorder output hold, and self-test diagnostics shall be provided.

.14 Connections between the turbidity analyzer(s) and the controller shall be “plug and play.”

.15 The Interface unit shall allow operators to control sensor and interface functions with menu-driven software and shall provide data logging of measurement data.

.16 The interface unit shall have a built-in data logger with the capacity to store data on 15-minute intervals for up to 6 months.

.17 The interface unit shall be housed in a NEMA-4X (indoor) industrial metal/plastic enclosure.

.18 The DC power supply shall be housed in the interface unit.

.19 The DC power supply shall automatically accept input in the range of 100 to 230 Vac, 50/60 Hz.

.20 All system components shall be ETL listed to UL 61010A-1, certified to CSA C22.2 No. 1010.1, and CE certified by manufacturer to EN 61010-1.

.21 All system components shall be CE certified by the manufacturer to EN 61326 (industrial levels) for immunity and emissions, Class A.

.22 All system components shall meet FCC Part 15 for North America and Canadian Interference-Causing Equipment Regulation ICES-003, and CISPR 11 Class A levels for rest of the world.

2.3.3 Analyzer and flow cell shall be mounted as indicated on the Contract Drawings with all necessary piping, valves, and appurtenances as required.

2.3.4 Sample Flow 0 – 60 litres per hour

2.3.5 Mounting: Existing backpanel

2.3.6 Provide the following accessories in the package:

.1 6 mm ball valve for inlet isolation (Chemline);

.2 Piping, tubing and fittings for sample inlet and drain

2.3.7 Acceptable Product: Hach TU5300sc Low Range Laser Turbidimeter or approved equal.

3 EXECUTION

3.1 Field Services

3.1.1 Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in Sections 13100, 13560, and 01820.

3.1.2 Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. The CSS shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of common construction or cleaning chemicals that may affect instrument operation.

END OF SECTION

1 GENERAL

1.1 Intent of Section

1.1.1 This section covers the work necessary to furnish electromagnetic meters, to measure raw water flow through the low lift pump discharge headers at the Blind River LLPS.

1.2 Related Sections

1.2.1 DIVISION 1 – GENERAL REQUIREMENTS

1.2.2 DIVISION 11 – EQUIPMENT

1.2.3 DIVISION 13 – INSTRUMENTATION, CONTROL AND SCADA

1.2.4 DIVISION 16 – ELECTRICAL

1.3 GENERAL

1.3.1 Equipment provided under this section shall be fabricated, assembled, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, manufacturer's instructions unless exceptions are noted by the Engineer.

1.3.2 Equipment and services provided under this section shall be subject to the requirements specified in Section 13100 – Control & Instrumentation and Section 13560 – Instrumentation General Requirements. This section shall be used and referenced only in conjunction with Section 13560 – Instrumentation General Requirements. Supplementing Section 13560 – Instrumentation General Requirements, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule. Equipment and services in this section shall be provided by the Section 13100 – Control & Instrumentation.

1.3.3 Section 13100 – Control & Instrumentation shall apply to all systems described in this section. All applicable requirements defined in Section 13100 – Control & Instrumentation shall apply to equipment and services provided under Section 13560 – Instrumentation General Requirements.

1.4 SUBMITTALS

1.4.1 In accordance with Section 01330 - Submittals.

1.4.2 Complete detailed specifications, and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section.

1.4.3 Detailed information regarding the magnetic flowmeter shall be provided for record purposes, including materials, methods of application, maintenance requirements, and other pertinent data.

1.4.4 The shop drawing submission shall include, but shall not be limited to, the following:

.1 General dimensional information and materials of construction

.2 Installation details, including dimensions, flange ratings, flange styles, and external wiring requirements

.3 Input and output signal ranges and calibrated ranges

.4 Product Options

.5 Descriptive material in sufficient detail to show the general construction pertinent to the proper review of the equipment

.6 All ancillary equipment to be provided by the Supplier shall be listed.

1.5 APPLICABLE CODES AND STANDARDS

1.5.1 The following minimum applicable codes, standards and regulations must be adhered to in the design, installation and services provided by the Vendor. In the case of conflicting information among these codes, it is the Vendor's responsibility to inform and obtain written approval from the Purchaser of any exceptions hereby taken.

1.5.2 Requirements from the following organizations shall be considered as a minimum:

.1 OSHA – Occupational Safety and Health Act

.2 ANSI – American National Standards Institute

.3 UL – Underwriter Laboratories

.4 CSA – Canadian Standards Association

.5 NIST – National Institute of Standards and Technology

.6 CE – Conformité Européenne

.7 City, Regional, Provincial Codes

2 PRODUCTS

2.1 SERVICE CONDITIONS

2.1.1 Two (2) electromagnetic flowmeter assembly shall be provided to measure the flowrate through each low lift pump discharge header at the LLPS.

2.2 GENERAL REQUIREMENTS

2.2.1 All readouts, indicators, recorders, etc., shall be in metric units, whether shown or not and in engineering scales. All final units, ranges, set points, colours, etc., will be finalized on the shop drawings.

2.2.2 Mounting brackets, hooks, plates, screws, bolts, anchors, etc., shall be stainless steel and of sufficient size to permanently mount the equipment.

2.2.3 Each instrument mechanism shall be within a CSA rated NEMA 4X enclosure.

2.2.4 The flowmeter shall be a velocity sensing electromagnetic type, complete with a solid-state electronic signal converter, sealed housing, flanged tube meter for 150 psi working pressure.

2.2.5 The meter shall be manufactured to the highest standard available for magnetic flowmeters.

2.2.6 The magnetic flowmeter shall have a digital indicator having a range of 0 to a specified flow and shall be equipped with a six-digit digital totalizer for forward reading.

2.2.7 The magmeter shall be resistant to abrasion and chemical corrosion and be capable of measuring the continuous flowstream despite the presence of solids.

2.2.8 The magmeter must be fully operational in full pipe conditions. An empty pipe detector shall be provided to ensure that the outputs are driven to a predetermined flow condition when the electrodes become uncovered.

2.2.9 The magmeter shall be properly sized to ensure the flow velocity through the meter shall be within the range of 0.3 - 5 m/s.

2.2.10 Installation Requirements: Not less than 5 pipe diameters upstream & 3 pipe diameters downstream to obtain rated accuracy.

2.2.11 Performance requirements:

Number of Pulse/Frequency Output	1
Current Output	0/4-20mA DC into 0-600W load
Minimum Pressure Limits of Liner	150 psi @ 60°C

2.2.12 Flowmeters shall be installed in the following locations and be sized as follows:

Location	Tag Number	Liquid Type	Pipe Size, mm	Number of units	Flow, L/s
Low Lift Pump Discharge Header 1	FIT0111	Raw water	250	1	0 – 60
Low Lift Pump Discharge Header 2	FIT0121	Raw water	250	1	0 – 60

2.2.13 All flow transmitters supplied shall have latest firmware from manufacturer.

2.2.14 All flow transmitters supplied shall be compatible with and enabled for performing self verification through Heartbeat Technology, Smart Meter Verification, Ability Verification or Owner's approved equivalent.

2.2.15 As part of installation and commissioning, a detailed flowmeter verification report shall be generated for each new flow transmitter. The verification report shall contain both verifications of the sensor and the transmitter. The verification report shall show an overall verification result of "Passed" and be presented to the Owner, otherwise the flow transmitter will not be accepted by the Owner.

2.3 FLOW TUBE

2.3.1 End Connection: SS304, ASTM-A774 for fittings as Schedule 10S

2.3.2 Flow Meter Body and Grounding Rings:

.1 The meter body shall be fabricated of SS304 pipe with SS flanges.

.2 Grounding Rings (in non-conductive or insulated pipe installations): SS304.

2.3.3 Electrodes: 316L SS, Bullet nose

2.3.4 Empty Pipe Detect: Yes.

2.3.5 Carbon steel body and flanges with lining shall not be acceptable.

2.3.6 Size to suit installation location. Flanged connection type to suit installation location and process piping.

2.4 TRANSMITTER

2.4.1 Each flowmeter shall come with remote display option.

2.4.2 Panel mounted enclosure, LCD display, and digital output for reverse flow detection. Remote flow transmitter to be mounted within the flow meter panel located in unclassified area as shown on the contract drawings.

2.4.3 Power Supply: 120VAC/60Hz.

2.4.4 Output: 4–20mA with HART isolated, additional 24VDC scaled pulse output contact for totalizing flow, One (1) Form C SPDT fault relay

2.4.5 1 Form C SPDT fault relay.

2.4.6 Pulse Output: 1 Pulse/m^3.

2.4.7 Calibration Range: As indicated above.

2.4.8 Accuracy:

.1 ± 0.3 percent of measured value, maximum error over entire velocity range

2.4.9 Repeatability: plus or minus 0.05 %.

2.4.10 Local Display: LCD, rate of flow and flow totalized displayed in engineering units, flow (L/s) and totalized flow (L or m3).

2.4.11 Continuous automatic re-zeroing calibration and auto ranging.

2.4.12 Flow meters are to include HART communication

2.4.13 Flowmeter shall perform self-calibration through Hart.

2.4.14 Provide a minimum of 30m of signal cables, but the Manufacturer shall confirm the required length (plus 3m additional coil). Cables shall be neatly arranged and grouped together with heavy duty tie raps.

2.4.15 Provide calibration certificate with installed flow meter and include in Operations and Maintenance Manual. Calibration is to include at least 5 tested points distributed evenly across the full specified flow range.

2.4.16 Accessories: Protective inlet grounding ring (stainless steel).

2.4.17 Shop testing shall be performed to ensure that the electromagnetic flow meter is free of defective parts, cracks or any other defects.

2.4.18 In the event that a component fails to perform as specified or is proven defective in service during the warranty period, the manufacturer shall promptly repair or replace the defective part at no cost to the Owner. Include regular field services and maintenance work as required to satisfy extended warranty.

2.5 ACCEPTABLE MANUFACTURERS

2.5.1 The below Supplier list shall not be construed as automatically acceptable, but the Owner or Engineer shall have the right, in its sole and absolute discretion, to accept or reject the shop drawing if the Supplier selected by the Contractor does not comply with the Contract Drawings and specification requirements herein.

2.5.2 Rosemount 8700,

2.5.3 ABB WaterMaster

2.5.4 or Approved Equal.

2.6 WARRANTY

2.6.1 The electromagnetic flow meter shall be warranted against defects in workmanship and materials for a minimum of five (5) years from the date of installation.

3 EXECUTION

3.1 INSTALLATION

3.1.1 The electromagnetic flow meter shall be installed in accordance with the manufacturer's drawings and instructions. Suitable electromagnetic flow meter mounting configurations shall be specified and determined by the vendor with the Engineer's approval.

3.1.2 The electromagnetic flow meter shall be mounted in accordance with Contract Drawings.

3.1.3 The converter shall be supplied complete with the totalizer and all its electrical components shall be remotely mounted from the electromagnetic flow meter electrode element.

3.2 VOLUMETRIC TESTING

3.2.1 Volumetric testing of all meters shall be performed and approved prior to shipment.

3.2.2 The complete meter assembly and signal converter must be accuracy tested and calibrated in accordance with NIST standards at near minimum, intermediate and maximum Manufacturer's specified flow ranges of meter.

3.2.3 The test facility shall be certified annually to an accuracy of ±0.5% and be traceable to the NIST. If desired, the Engineer or their selected agent shall witness the tests and a copy of the certified accuracy test records must be furnished at no charge to the Owner.

3.3 FIELD QUALITY CONTROL

3.3.1 Installation Check. The electromagnetic flow meter manufacturer shall provide the services of a qualified field representative according to the quality control section to assist during installation of the equipment by the Contractor. As a minimum, the manufacturer's field representative shall be made available as follows:

.1 Installation and Startup 2 trips, 8 hours total

3.3.2 Training. Training shall be in accordance with Section 01820 – Demonstration and Training.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers the supply, delivery, supervision of installation, testing, and commissioning of the following equipment:

.1 Chlorine residual analyzers to measuring free chlorine residual, complete with sensors, sensor signal cables, sensor housings, reagents (if applicable) and accessories such as pressure reducing and flow control valves as required by the manufacturer. Acceptable manufacturers are listed herein.

1.1.2 This section describes the general requirements, operating conditions, shop drawings, the product, and execution of installation, start-up, inspection, testing, and commissioning.

1.1.3 The Contractor shall be responsible for overall coordination of the above equipment to ensure their compatibility with the sample stream, sensor housing, mounting hardware and control equipment.

1.2 Intent of Section

1.2.1 The section intends to specify the general requirements, product and execution required for the chlorine residual analyzer equipment stated under the scope.

1.2.2 This section does not include the equipment for the introduction of chemicals into the system.

1.2.3 The plans and specifications are intended to set the acceptable minimum and shall not be construed to relieve this Contractor of the responsibility of:

.1 Installing a complete, trouble free system

.2 Good workmanship

1.3 General

1.3.1 Refer to Section 10010 for General Requirements.

1.3.2 The contractor is to clearly identify on the shop drawings any deviation from the specification.

1.3.3 Contractor is to furnish copies of the manufacturer's warranties.

1.3.4 Supply, install and test all meters and transmitters as shown in the Contract Drawings, as specified herein, in accordance with Manufacturer's recommendations and as approved by the Engineer.

1.4 Related Sections

1.4.1 DIVISION 1 – GENERAL REQUIREMENTS

1.4.2 DIVISION 11 – EQUIPMENT

1.4.3 DIVISION 13 – SPECIAL CONSTRUCTION

1.4.4 DIVISION 15 – MECHANICAL

1.4.5 DIVISION 16 – ELECTRICAL

1.5 References

1.5.1 ANSI/ISA-S5.1-1984 Instrumentation Symbols and Identification.

1.5.2 ANSI/ISA-S5.4-1976 (Revised 1989) Instrument Loop Diagrams.

1.5.3 ISA-S20-1981 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves or most current standard.

1.6 Measurement and Payment

1.6.1 Work outlined in this section is included in the lump sum bid price.

1.7 Operating Conditions

1.7.1 The following site operating and water quality conditions must be assumed for all design calculations:

.1 Process Fluid: Raw Water

.2 40^0C maximum/5^0C minimum ambient air temperature

.3 25^0C maximum/0.5^0C minimum water temperature

.4 95% maximum relative humidity (non-condensing)

.5 7.5 – 9 water pH

.6 Normal Range: 1 to 2 mg/L with Extreme Range: 0 to 5 mg/L

.7 Fully enclosed facility

1.8 Shop Drawings

1.8.1 Submit the Shop Drawings for review in accordance with Section 01330 – Submittal Procedures.

1.8.2 The shop drawing submission shall include, but not be limited to, the following:

.1 Provide basic design details for each piece of equipment, including exact catalogue or model numbers, input output signal ranges and calibrated ranges, all interlocks and connections, product options, control schematics and wiring diagram(s).

.2 Descriptive material in sufficient detail to show the general construction pertinent to the proper review of the equipment.

.3 General dimensioned layout and mounting detail.

.4 A precise list of all electrical requirements for the equipment including cable and wire requirements, all controls monitoring equipment and instruments shall be given including all power characteristics.

.5 A list of recommended spare parts and recommended replacement frequency, including replacement of the chlorine sensor, and individual price for each item.

.6 The supplier shall indicate recommended manufacturer preventative maintenance frequency and cost per visit.

.7 All ancillary equipment to be provided by the Supplier shall be listed.

.8 Special accessories or tools for the adjustment or removal of parts required for any piece of equipment shall be listed and furnished as part of the supply.

.9 Factory test result documents, where applicable.

1.9 Maintenance Data

1.9.1 Refer to Section 01780 – Closeout Submittals.

2 PRODUCTS

2.1 General Requirements

2.1.1 Work includes supply, delivery, installation, commissioning and training for free chlorine analyzers, as shown on the contract drawings and as specified herein.

2.1.2 The sensors, sensor housings and analyzers shall be of the same Manufacturer to assure compatibility and provide sole source responsibility.

2.1.3 The manufacturer shall provide a one-year warranty on all system components. All components shall be fully tested prior to shipping.

2.1.4 The Contractor shall supply all components necessary for a functional system, including sample line piping and valves to sensor housing and from sensor housing to drain, and all accessories required for the proper performance of the analyzers.

2.1.5 The Contractor shall supply if necessary, sampling pumps of adequate capacity and/or pressure reducing valves for the sample flows in accordance with Manufacturer's recommendations.

2.1.6 The Contractor shall provide connection of sample flow to the sensor housings, if applicable.

2.1.7 Sample water from the sensor assembly shall not be contaminated and shall be capable of being directly discharged to drain.

2.2 FRee Chlorine Residual Analyser

2.2.1 Analyzer and flow monitor shall be mounted as indicated on the Contract Drawings with all necessary piping, valves, regulators ,and appurtenances as required.

2.2.2 The manufacturer of the above specified equipment shall warranty it for a period of 24 months from the date of commissioning. In the event that a component fails to perform as specified

or is proven defective in service during the warranty period, the manufacturer shall promptly repair or replace the defective part at no cost to the Owner. Include regular field services and maintenance work as required to satisfy extended warranty.

2.2.3 Each analyzer shall be supplied with a label in accordance with Section 11005 – Identification of Equipment and Valves.

2.2.4 The chlorine residual analyzer shall include a controller with the following channels.

.1 One channel measuring free chlorine (sodium hypochlorite).

2.2.5 The chlorine analyzer shall comply the minimum performance:

.1	Measurement Range:	0.05 to 5.00 mg/L (min)
.2	Accuracy:	Better than +/- 2% of measured value
.3	Sample flowrate:	0 to 60 litres per hour (max)
.4	Response time to:	90% step change in two minutes.
.5	Drift:	< 2% per month.
.6	Calibration:	One-point calibration (no “0” point) Residual measurement freezes during Calibration

2.2.6 The sensors shall conform to the following specifications:

.1	Type:	Amperometric.
.2	Electrode Protection:	None
.3	Temp. Compensation:	None
.4	Reagents:	None
.5	pH Probe:	None
.6	Max feed pressure:	15 psi or as stated by manufacturer.
.7	pH Correction:	Included
.8	Probe Holder:	For single probe
.9	Flow control:	None

2.2.7 The Transmitter and Controller conform to the following specifications

.1	Enclosure:	Wall mounted
.2	Cabinet mounting:	IP 54 (based on NEMA 4 X)

.3	Power Supply:	115VAC 60Hz Single Phase
.4	Sensor Cable	As required.
.5	Analogue Outputs:	2x 4-20mA Isolated 600 Ohm Max.
.6	Relay Outputs:	2 x alarm and 1 x general fault
.7	Alarm delay:	Switch-on & Switch-off delay. Programmable 0-9999 sec.
.8	Indication:	LCD Display of: Measured Value, Status, Error Conditions, Display turns Red in Error
.9	Touch Keypad:	Provide with Menu-Driven Calibration
.10	Security:	Pass code to restrict access to configuration settings
.11	Data Logging:	Data logging for measured value, control Variables, calibration data and events, stored on SD Card.

2.2.8 Flow Cell Assembly

.1 The flow cell assembly shall contain a rotameter with a measuring range of 20 to 80 L/hr, with graduations in 10 L/hr increments.

.2 The flow assembly shall provide flooded probe holder downstream of the rotameter that is filled from the top. The probe holder shall be fitted with an intrinsic drain valve for draining it.

.3 Do not include a flow switch option.

.4 Flow cell assembly must be equipped with compression fittings for 0.25” poly tubing

2.3 Other for Chlorine Residual Analyzer

2.3.1 Supply and install the pressure regulation and flow control per manufacturer recommendation.

2.3.2 Pressure Regulation: Chemline S.R 50 Series PVC Pressure Regulating Valve or approved equivalent.

2.3.3 Sample Flow Control: As recommended by manufacturer and approved by Engineer.

2.3.4 Supply and install two (2) upstream Filters

.1 Filter: 10” filter, 1-micron, 10” high x 2.5” diameter, to fit “standard 10 inch water filter housing”: Make Watts, Model: FPMB1-978

.2 Filter Housings: Watts, clear lucite, with 0.5” FNPT fittings, pressure relief “button”, with adapters for 0.25” poly tube, One option: Watts PWHP1012BPR

.3 Filter Housing Bracket: Watts PWMBVIH

.4 Bracket for two filter housings

.5 Filter In/Out/Bypass ball valves: PVC

.6 For Filter elements, an alternate supplier is VIQUA, model: SW1-1

2.3.5 Electrolytic caps (consumable): p/n 790488

2.3.6 Electrolyte solution, 100mL (consumable): p/n 506270

2.4 Approvals

2.4.1 Approval from C.S.A. is required.

2.5 Sensor Housing

2.5.1 The sensor housing shall be of transparent PVC material and of in-line modular in-line type to house the chlorine sensors and pH sensor (where required).

2.5.2 A flow sensor to be mounted on the inlet of the sensor housing shall be provided to provide alarm indication of loss of flow at the sensor.

2.6 Spares

2.6.1 Contractor shall provide one spare free chlorine residual probe, four spare electrolyte caps, and four spare vials of electrolyte

2.7 Acceptable Product

.1 Wall-mount Analyzer: Prominent DACb, model: “DACbW006VA0000010000” or equivalent model from Prominent.

.1 Probe: ProMinent 1019398 (0-2 ppm free chlorine, “CLE 3.1 - mA” series), comes with 100mL of electrolyte in bottle

.2 Flow cell with rotometer: p/n DGMA101T010

.3 Needle valve: Chemline p/n NGA002

.4 Connections for 0.25” poly tubing

3 EXECUTION

3.1 General

3.1.1 The chlorine analyzer supplier shall provide site services as required to facilitate analyzer installation including site supervision during installation, commissioning and training.

3.1.2 Install all instruments in strict accordance with the manufacturer's requirements and recommendations.

3.1.3 Use stainless steel hardware for all installations. Ensure all supports are retractable to provide convenient access for maintenance and servicing of instrumentation.

3.1.4 Contractor to wire all alarm points in a 'fail safe' configuration, such that the loss of power, opening of the contact or break in the control circuit wiring will activate a SCADA alarm.

3.1.5 Ensure all installations allow for ease of access for future maintenance and calibration.

3.2 Site Verification

3.2.1 Complete field performance verification upon installation of the chlorine analyzer.

3.3 System Start-Up and Commissioning

3.3.1 Refer to Section 01810 – Testing and Commissioning

3.3.2 All instrumentation equipment is to be checked and adjusted by a competent service representative of the respective instrument manufacturer or supplier. After all calibration and other adjustments are carried out, and the equipment is fully operable, the accuracy, serviceability and function of all units are to be demonstrated to the Engineer's satisfaction. Upon completion of this work, provide copies of a written report to the Engineer and include in the final Operations and Maintenance Manuals.

3.3.3 Provide on-site assistance to complete I/O check and to be present during initial testing of software. Work with Owner's Representative during site start-up of system.

3.3.4 The chlorine analyzer supplier shall provide site services as required to facilitate flow meter commissioning including (but not limited to) the following: supervision during start-up (minimum two days), training (minimum two days), commissioning (minimum two days), one year inspection and analyzer verification (two days). Do not assume any of the specified days above will overlap.

3.4 Installation and Inspection

3.4.1 The chlorine residual analyzers shall be installed as indicated on the Contract Drawings, in accordance with the Manufacturer's recommendations, and as approved by the Engineer.

3.4.2 Refer to Section 01820 – Demonstration and Training.

3.4.3 Provide the services of a factory trained representative to inspect, operate, test, adjust, and troubleshoot the installation.

3.4.4 The factory trained representative, mentioned above, will certify that the equipment is ready for operation before use. In addition, the factory trained representative shall instruct the owner's operation personnel of the proper operation and maintenance of the equipment supplied.

3.4.5 Provide for additional supervision of installation by equipment Supplier as required.

3.4.6 Arrange with the Engineer a mutually agreeable date when the representative should be on site.

3.4.7 Submit a report, signed by the Manufacturer's representative, describing in detail the inspection, tests, and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment conforms to all specifications.

3.4.8 Inspection to include checking for:

.1 cracks and other damaged or defective parts. The equipment must be undamaged, without cracks and free of defective parts.

.2 completeness of installation as specified and as recommended by the Manufacturer.

.3 correctness of setting, alignment and relative arrangement of various parts of the system.

.4 Follow manufacturer's instructions.

.5 Use separate conduits for signal and power wiring.

.6 Avoid custom cable lengths if possible.

3.5 Testing and Certification

3.5.1 After start-up and prior to final acceptance, the Contractor shall conduct Engineer witnessed performance tests on the equipment.

3.5.2 The field service representative will perform functionality tests of all the functions the chlorine residual analyzer and temperature transmitter are designed to perform. Tests will be scheduled with the Engineer at least two (2) weeks prior to the planned test date.

3.5.3 The field service representative shall submit to the Engineer a written report stating that the equipment has been checked and is suitable for operation.

3.6 Supervision of Installation and Commissioning

3.6.1 Test and commission the equipment in accordance with section 01810 – Testing and Commissioning.

3.6.2 At the completion of satisfactory installation, each unit shall be started by the General Contractor under the supervision of the Supplier and in cooperation with plant operations staff. All controls and alarms shall be checked and tested to ensure proper control and equipment protection.

3.6.3 Equipment shall only be accepted after receipt of a satisfactory report submitted by the Manufacturer's representatives.

3.6.4 Modify or replace equipment or materials failing required tests.

3.6.5 Perform additional testing required due to changes of materials, and/or failure of materials or construction to meet specifications at no extra cost to the Corporation.

3.7 Storage

3.7.1 Prior to the installation, the chlorine residual analyzer, temperature transmitter, sensors and accessories should be protected and stored indoors in a dry area, in accordance with the Manufacturer's recommendations.

3.8 Maintenance

3.8.1 Provide maintenance on Supplier's material as required by the Supplier from the date of delivery to the initial start-up.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 The work consists of supply and installation of fiber and copper communications links hardware and retrofit to new IT panels as shown on the drawings and specified herein, including modifying the existing SCADA (Supervisory Control and Data Acquisition) network at the Blind River WTP:

.1 New Blind River Low Lift Pumping Station IT Panel (IT-0001)

.2 New Instrument Control Panels, including vendor supplied panels

.3 New MCC digital meters

1.1.2 The work also consists of supply and installation of Ethernet communication links between the ICP and other equipment as shown on the drawings and specified herein.

1.1.3 This specification is intended as a functional description of the components required and shall serve as a guide to the contractor in providing the respective communications link.

1.1.4 The Contractor is required to visit the site to verify routing of cables, placement of all panels and cabinets.

1.1.5 The Contractor will be required to submit supplier designed complete drawings to suit the following:

.1 Fiber optic communications as shown on the contract drawings.

.2 CAT6 communications to suit all applications shown on the on the contract drawings.

1.1.6 The Contractor is responsible to furnish the materials, tools and equipment required to perform the tasks outlined in this document. All risks or loss or damage to the equipment during and until delivery as a result of fire, theft, water malicious mischief, or other cause shall be borne by the Contractor. This responsibility shall continue until receipt and acceptance by the Owner.

1.1.7 All areas affected by installation, both inside and outside the building shall be restored to their former condition at contract, as agreed upon between this contractor and the Owner. The contractor is responsible for the cost of all repairs, painting, and other restoration needed due to damage caused by the installation.

1.1.8 The Contractor shall be responsible for the storage and safeguarding of material, supplies and tools. This Contractor is responsible for the removal of all trash and debris from the site at the end of each working day.

1.2 Work Included

1.2.1 The Contractor shall be responsible for the:

.1 Supply, installation, and commissioning of the fiber optic communications cables as specified herein and shown on the drawings to suit the SCADA and network links.

.2 Supply, installation, and commissioning of the CAT6 communications between the new IT Panel and the VFDs**.**

.3 Provide CAT6 copper communications, work area outlets, and related hardware to suit the Ethernet communication applications identified on the drawings.

.4 Provide RS485 serial communications and related hardware to suit the Modbus communication applications identified on the drawings.

.5 Provide tagging of all communications equipment, devices, wiring in accordance with the Town of Blind River SCADA Standards.

.6 Provide CAT6 cabling from each new ICP and HMI panels as shown in the contract drawings to each respective IT Panel.

.7 Preparation of all descriptive data, schematic layout and interconnecting wiring diagrams for submission and review herein specified and in accordance with the requirements of the contract and Division 1.

.8 Shop fabrication and testing of panels and including all interconnecting cables to all devices and wiring to terminal blocks.

.9 Supervision, calibration, and communication cabling checkout in the field to the Engineers satisfaction. The contractor will be responsible for complex loops checkout and shall submit to the Engineer in writing (typed) verification and results of said loop checkout, including details of testing and setting of equipment, prior to commissioning.

.10 Provide complete record drawings. Drawings to be produced using AutoCAD latest version program and supplied to the customer. Also provide one print set reproducible record drawings (size A1). The Contractor shall also be responsible for providing detailed wiring diagrams, and equipment manuals, upon satisfactory commissioning and certification of work. PDF drawings or using the contract drawings will not be reviewed.

.11 The installation, wiring and point-by-point checkout of all communications cabling. The Contractor shall submit to the Engineer typed verification of all testing procedures and testing results.

.12 The installation and wiring of all communications cabling and equipment supplied under this contract.

.13 Provide communication certificates for Fiber, Modbus, and CAT6 cabling upon completion of the work for the Owner's approval.

.14 Commissioning of all equipment by the manufacturer's representative.

1.3 Submittals

1.3.1 Submittals shall be made in accordance with the requirements of division 1 and division 16.

1.3.2 A detailed submittal package identifying the equipment to be supplied shall be furnished.

1.3.3 A complete network architecture showing point to point for each cable type. Contractor shall generate drawings specific to each control panel illustrating, cable type, tag, colour, and

termination point at each end in compliance with the Town of Blind River SCADA requirements. The contract drawings may be used for reference only and shall not be used or included in the shop drawings that are to be reviewed by the Engineer/Owner. Shop drawings in CAD format are to be approved prior to installation.

1.3.4 The intent of the submittal is to ensure complete project scope coverage and does not relieve the contractor from fulfilling specified requirements.

1.3.5 Identification of the respective responsibilities of each part to the project. Include what is provided by the manufacturer and what is to be subcontracted, etc.

1.3.6 Preparation of point-to-point networks communications schematic diagrams that identify all communications links and including but not limited to the following:

.1 Each individual fiber strand of each cable bundle including cable colour code

.2 Termination connectors

.3 Closet connector panels

.4 Closet connector Patch Panels

.5 Patch cables

.6 End user network cable equipment and related equipment description

1.3.7 Fiber communications cabling backbone drawings must meet TIA/EIA-598B “optical fiber cable colour coding” and be stamped by a Registered Distributed Designer (RCDD). Acceptable Designer: Anixter Telephone #: 905-502-2349 or approved equivalent.

1.3.8 The submittal shall consist of legible printed text and high quality MicroStation drawings (size AI) bound in three-ring notebooks with index tabs that identify major sections of the document.

1.3.9 The submittal shall address all hardware and software to be supplied. In addition:

.1 Description of the major user related features and operating characteristics of the proposed system.

.2 All significant equipment to be supplied shall be listed followed by descriptive data sheets. The equipment list shall include each component name, manufacturer, model number, description of the operation, quantity supplied and special set-up and operation and maintenance characteristics.

.3 In addition to data sheets, all shop drawings are to be provided in adobe pdf format.

.4 Include as part of the shop drawing submittal to include, as a minimum, the following information:

.1 Installation details including material list, dimensions, and external wiring requirements.

.2 Fiber Optic Communications Network Drawing.

.3 Fiber Optic routing path drawings.

.4 Cable and wire requirements (include cable specs)

.5 Tag numbers

.6 Exact catalogue or model numbers

.7 Submit certified (RCDD) LAN/WAN drawings

.8 Identify specific locations for panels. Engineer reserves the right to relocate panels

.9 Factory test result documents

.10 Project name and job numbers (customer and contractors)

.5 The Contractor shall provide a complete commissioning plan, outlining the following:

.1 Detail equipment to be commissioned

.2 Procedures to commission each piece of equipment

.3 Schedule

.6 All copies (sets) submitted must be of equal quality and legible. Submissions considered being of poor quality or illegible or lacking in sufficient detail shall not be reviewed and will have to be resubmitted.

1.4 Operations and Maintenance Manuals

1.4.1 The following printed materials shall be provided:

.1 Detailed (O&M) manuals shall be provided with complete information concerning the operation of the system and support necessary with diagnostic test results where applicable.

.2 Data sheets shall be supplied for all significant equipment used in the system. The data shall include, as a minimum, the component name; manufacturer; model number, quantity and special (O&M) characteristics, setup or passwords:

.1 Multi-Strand fiber optic cable

.2 Individual strand identification and termination

.3 Communications devices to suit the respective communications application

.4 Panel locations and tags

.5 Panel details including panel/port designations

.6 Patch cables and termination types.

.3 Data sheets shall be supplied for all equipment used in the communication system. The data shall include, as a minimum, the component name, manufacturer, model number, quantity and any special (O&M) characteristics, setup, or passwords.

.4 Provide End-to End insertion loss data for all fibre.

.5 Individual Splice Loss data.

.6 “As installed” communications diagrams.

.7 OTDR Traces.

.8 Connector Insertion Loss Data.

.9 Final as-built drawings of equipment shall be provided, and a minimum include:

.1 Overall dimension details for each equipment and all door mounted devices including nameplate designations.

.2 Interconnecting wiring diagrams of all control equipment, PLC, and other system equipment including connection and interface with existing wiring.

.3 Control loop verification data sheets for each fiber termination pair.

1.5 Training

1.5.1 The Contractor shall provide training for three employees on how to make patch connections, configure and test equipment.

1.5.2 The Contractor will be expected to provide a sufficient level of training to the Engineers satisfaction to allow for installation and maintenance to be carried out to the manufacturer’s specifications.

1.5.3 The Contractor shall clearly describe user training provided, including materials and procedures employed.

1.5.4 During the warranty period, this Contractor shall provide additional training to additional personnel as need is determined by the Engineer at the installation site.

1.5.5 The Owner may elect to maintain its equipment. This contractor is requested to indicate availability and approximate costs of suitable training programs.

1.6 Quality Assurance for Fiber Optic Cables

1.6.1 The materials, design, and workmanship employed in the manufacture of all equipment shall conform to the latest Town of Blind River SCADA standards for fiber cables. Proposed fiber cables and fiber equipment shall be reviewed by the engineer and owner prior to procurement and install.

1.6.2 The cable must meet the requirements of the Canadian Electrical Code ® (CEC)® section 4.

1.6.3 Non-Plenum Applications – Applicable Flame Tests: CUL 1666. All-dielectric cables shall be listed OFNR. Interlocking armoured cables shall be listed OFCR.

1.6.4 Finished cables shall conform to the applicable performance requirements of the Insulated Cable Engineers Association, Inc. (ICEA) *Standard for Indoor-Outdoor Optical Fibre Cable* (ICEA S-104-696.

1.6.5 Fiber cabling will be routed through indoor pathways and spaces, it shall be listed for indoor use in accordance with Article 770 of the National Electrical Code.

1.6.6 Indoor/Outdoor cable used in the building backbone shall be fully compliant with ANSI/ICEA S-104-696.

1.6.7 Indoor cable used in the building backbone shall be fully compliant with ANSI/ICEA S-83-596.

1.7 Quality Assurance for Ethernet Cables

1.7.1 The materials, design and workmanship employed in the manufacture of all equipment shall conform to the applicable standards for Ethernet Cables, Category 6e type:

.1 ANSI/TIA/569-A-1-2000 – Surface Raceways

.2 ANSI/EIA/TIA-569-A-2-2000 – Furniture Pathways & Spaces

.3 ANSI/EIA/TIA-569-A-3-2000 – Access Floors

.4 ANSI/EIA/TIAAAA 569-A-4-2000 – Poke Thru Fittings

.5 ANSI/EIA/TIA/569-A-7-2001 – Cable Trays and Wireways

1.8 Quality Assurance for Copper Cables

1.8.1 The materials, design, and workmanship employed in the manufacture of all equipment shall conform to the applicable standards for Copper cables.

1.8.2 The cable must meet the requirements of C (UL) CEC approved as communications cables meeting the requirements of the Bi-National Standard CSA C22.2 No. 214/UL 444 and Section 60 of the Canadian Electrical Code, Part 1 (CEC) The C (UL) cable designation (and its meaning) would be one of the following:

.1 CMP – Cable meeting CSA FT6 or UL 910

.2 CMR – Cable meeting UL 1666

.3 CMG – Cable meeting CSA FT4

.4 CM – Cable meeting UL 1581, Sec. 1160 (Vertical Tray)

.5 CMX – Cable meeting UP 1581, Sec. 1080 (VW-1)

.6 CMH – Cable meeting CSA FTI

1.9 Standards for Connectors

1.9.1 The following documents cover the specifications and performance for field-installable singlemode Fibre ST® compatible, FC, SC, and LC connectors.

1.9.2 The following documents may be used as references:

.1 EIA/TIA-455-A Standard Test Procedures for Optical Fibres, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fibre Optic Components (FOTPs)

.2 TIA/EIA-604-2 Fibre Optic Connector Intermateability Standard, FOCIS-2 (ST Compatible)

.3 TIA/EIA-604-3A Fibre Optic Connector Intermateability Standard, FOCIS-3 (Type SC)

.4 TIA/EIA-604-4A Fibre Optic Connector Intermateability Standard, FOCIS-4 (Type FC)

.5 TIA/EIA-604-10A Fibre Optic Connector Intermateability Standard, FOCIS-10 (Type LC)

1.10 Standards

1.10.1 Comply with the requirements of the latest edition of the applicable CSA standards, the requirements of the Authorities, Federal and Provincial and Municipal Codes, the applicable standards of the Underwriters Association and all other authorities having jurisdiction. These codes and regulations constitute an integral part of these Specifications. In case of conflict, the codes take precedence over the contract drawings.

1.11 Coordination

1.11.1 It will be the responsibility of the Contractor to coordinate this required works with the approved communication system supplier. It will be the responsibility of approved communication system supplier to perform the work to be completed under this division.

1.11.2 The Contractor will coordinate work with other divisions where there is an impact or overlap of work with this division.

1.11.3 Ensure that other divisions provide all necessary material and work required by this division for the installation of equipment and wire, which falls under the responsibility of this division.

1.12 Jobs Conditions

1.12.1 Examine the site and contract documents in accordance with these specifications and related sections. No extras for items that would have been visible at the site visit will be allowed.

1.12.2 Perform a site visit to verify exact quantities of cabling and other equipment as required.

1.13 Warranty

1.13.1 The Contractor shall pay for and obtain all necessary guarantees required in order to warranty that the entire communications system will perform as herein described for two years after substantial performance; therefore, this Contractor will pay for all suppliers

engineering required, including the necessary software configuration, software/firmware updates, shop drawings and site visits.

1.14 Communication System Supplier

1.14.1 The acceptable communication system supplier and installer for this section shall be one of the following:

.1 Ainsworth Electric 416-240-0610, Expertech Network Installation 905-836-5088, Guild Communications 416-288-8222, The State Group 416-240-0610, APCI 905-847-0010, Selectra Inc 519-271-0322, or Approved Equivalent

2 PRODUCTS

2.1 General

2.1.1 All equipment shall be complete with all necessary appurtenances to perform the functions indicated on the control drawings and electrical drawings with respect to input and outputs etc.

2.1.2 The equipment shall be complete with all accessory items, whether specifically mentioned or not, to provide completeness of installation and operation as intended.

2.1.3 Cable lengths:

.1 All CAT6 cables are to be less than 90 meters length, contractor to design the interior conduit path to keep the CAT6 cable runs within this limitation.

.2 All Single Fiber runs to be less than 1500 meters length, contractor to design the conduit path to keep the fiber run length within this limitation.

.3 In case of any deviation from above requirement notify the Engineer and Owner prior to running the cables.

2.1.4 Acceptable Manufacturer of all Fiber Optic System Cables and Components:

.1 Corning, or Approved Equivalent

2.2 Fiber Cable Single Mode

2.2.1 Approved Fiber Cable Single Mode Product

.1 Corning FREEDM Loose Tube, Gel-Free Cable, Riser, 12 F, Single-mode (OS2)

.2 Part Number: 012EUF-T4101D20 or approved equal

2.2.2 Supply Single Mode fiber optic cabling to suit communications between the new Blind River Low Lift Pumping Station and the Existing Blind River Water Treatment Plant as indicated on the drawings.

2.2.3 Provide Freedom Fiber Optic Cable with the number of strands for each fiber cable application as indicated on the drawings, 12 strands minimum.

2.2.4 Loose tube gel-free riser cables are flame-retardant, indoor/outdoor, riser-rated cables designed for interbuilding and intrabuilding backbones in aerial, duct and riser applications:

.1 Fiber Category: Singlemode (OS2)

.2 Central Element: Dielectric

.3 Fiber Count: 12

.4 Tape: Water-swellable

.5 Number of Ripcords: 2

.6 Outer Jacket Material: Flame-Retardant, UV-Resistant

.7 Outer Jacket Color: Black

.8 Wavelengths: 1310 nm / 1383 nm / 1550 nm

.9 Maximum Attenuation: 0.4 dB/km / 0.4 dB/km / 0.3 dB/km

2.3 Single Mode Connectors

2.3.1 All fiber connectors are to be SC type.

2.3.2 Strain relief: For ST compatible, SC, and FC connectors only, the connector will provide a strain relief mechanism for installation onto a single fiber cable that contains strength elements. The fiber within the body of the connector will be isolated mechanically from cable tension, bending and twisting.

2.3.3 Index matching material: The connector will require index-matching material within the splice components of the connector.

2.3.4 Intermateability: The connector will be designed in compliance with the appropriate TIA/EIA FOCIS document.

2.3.5 The SC, FC, and ST compatible connectors shall have a translucent back section allowing the use of a visual fault locator to help determine fiber contact during installation.

2.3.6 Installation on field fiber: The connector will contain a mechanical splice and require one tool kit to assemble all four connector types.

2.3.7 Installation rate: The connector will be installable upon 900 µm buffered fiber in one minute or less. The ST compatible, FC, and SC connectors will be installable upon 3.0mm jacketed cable in three minutes or less total time.

2.3.8 Installation polishing: The connector will not require polishing of the end face in the field. Connectors will have a factory-polished fiber stub in the connector ferrule.

2.3.9 Installation type: The connector installation will not require the use of epoxies.

2.3.10 Fiber protection: The connector's factory stub fiber will be secured with epoxy to protect the bare fiber from the ingress of air or waterborne contaminants and will secure the fiber in the ferrule micro-hole.

2.3.11 Packaging Requirements:

.1 The connector will be individually packaged in a manner to adequately protect the connector.

.2 Each connector will be equipped with a protective dust cap that does not contaminate the connector end face.

.3 The packaging will indicate the supplier part number, connector type, and date code.

2.3.12 Performance Requirements:

.1 Insertion Loss: When tested in accordance with FOTP-171, connectors will be consistently of insertion losses ≤ 0.4 dB (average) and ≤ 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure.

.2 Reflectance: When tested in accordance with FOTP-107, connectors will be consistently capable of reflectance values of ≤ -40 dB for SPC polished connectors and ≤ -50 dB for UPC polished connectors when installed in accordance with the manufacturer's recommended procedure.

2.3.13 The connector crimp-on mechanism shall protect the bare fiber from the ingress of air of waterborne contaminants. Connector shall be consistently of insertion losses <0.3dB (typical) and shall be <0.75dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be <-20dB. Boot colour shall be black.

2.4 Single Mode Patch Cords

2.4.1 Supply Patch cords for Single Mode Fiber as specified below:

.1 Manufacturer: Corning

.2 Part Number: 727202R5131003M, three-meter SM SC duplex patch cord. Quantity to suit +30% spare.

.3 Coordinate and confirm the patch cord connector end to suit the specific requirements of the application.

2.5 Copper (Ethernet) Patch Cords

2.5.1 Supply Patch cords from Ethernet Switches to Patch panels, and from Work Area Outlets to field equipment for all applications shown on the drawings:

.1 Lengths to suit

.2 Quantity to suit the applications + 10 spare

2.5.2 Provide colour coded patch cables and jacks in accordance with the Town of Blind River SCADA colour conventions. Proposed colour conventions shall be reviewed by the engineer and owner prior to procurement and install.

2.6 Fiber Patch Panels

2.6.1 Supply and Install fiber Patch panels to suit the respective control panel applications as indicated on the drawings.

2.6.2 Provide Buffer Tube Fan-Out Kits to suit the termination and connection of the fiber cables to the respective patch panels.

2.6.3 Wall Mountable Acceptable Closet Connector Housings:

.1 Corning - SPH-01P, WIC2-DOOR

2.6.4 Rack Mountable Acceptable Closet Connector Housings:

.1 Corning – CCH-01U/2U/3U/4U (as required)

2.6.5 Provide CCH connector panels, management covers, distribution frames, spools, and related connectors to suit the application.

2.6.6 Provide 50um duplex patch cords with connectors ends and lengths to suit the respective applications.

2.6.7 Provide 4 spare 50µm duplex patch cord.

2.6.8 The patch panel unit shall meet the design requirements of ANSI/TIA/EIA-568 and the plastics flammability requirements of UL 94 V-0. Manufacturer shall be ISO 9001 and TL 9000 registered. The unit shall be available in different sizes to accommodate different port count requirements. Housings shall be manufactured using 16-gauge Aluminum or equivalent for structural integrity and shall be finished with a wrinkled black powder coat for durability. Installation fasteners shall be included and shall be black in colour.

2.6.9 Patch Housings shall include a clamshell-type cable clamping mechanism to provide cable strain-relief. The cable clamp shall accept one cable from 9.5 to 28.6 mm in diameter. The cable clamp mechanism shall also handle multiple smaller fiber count cables when used with the multiple cable insert.

2.6.10 The housings shall be available with factory-installed connectorized cable stubs in multiple cable and connector types. Brackets shall be available that allow wall mounting of the rack-mountable hardware. The wall-mount brackets shall include space for jumper management panels.

2.6.11 The Closet Connector Housing panels shall be offered in 6-, 8-, 12-, 16- and 24-fiber panels for use with the LANscape® Solutions hardware products. The panels shall be able to be used with field-installable connectors or in applications where the pre-connectorized cables are routed directly from the equipment to the interconnect hardware.

2.6.12 Rack-mountable and wall-mountable connector housings shall accept an interchangeable connector panel. The panel shall be attached with two push-pull latches to allow quick installation and removal. Blank connector panels shall be available to fill unused space within

the housings. The blank connector panel shall be attached with at least two push-pull latches to allow quick installation and removal. The blank panels shall be manufactured from injection-molded polycarbonate and shall be finished with a wrinkled black texture to match the housing. Panels shall be manufactured from 16-gauge cold rolled steel or injection-molded polycarbonate for structural integrity. Panels shall be finished with a wrinkled black texture to match other hardware.

2.7 Ethernet Switches and Ethernet Patch Panels

2.7.1 Industrial Ethernet Switches – Provide Ethernet Switches inside the new IT panels as indicated on the drawings. Refer to the contract drawings for quantity.

2.7.2 Ethernet Patch Panels – Provide Ethernet Patch Panels inside the new IT panels, and ICP. Refer to the contract drawings for quantity of Ethernet patch panels and ports.

2.7.3 The Contractor shall provide all the required communication cables between Ethernet switches, work area outlets, Ethernet patch panels, and the PLCs.

2.8 Horizontal Distribution Cable – Ethernet

2.8.1 Supply and install Horizontal Ethernet communications cable to suit the communications requirements shown on the SCADA architecture drawings.

2.8.2 Horizontal distribution cable shall be Enhanced Category 6, 24 AWG, 4-pair unshielded twisted pair, UL/NEC CMR rated, with a plenum-rated PVC jacket. Individual conductors shall be FEP insulated. Cable jacketing shall be lead-free. Cable shall meet the performance requirements listed in the following table in addition to all other standard Category 6 performance requirements. Cable shall be supplied in reel-in-box. Cable shall be UL listed under file number E138034:

Frequency (Mhz)	Attenuation (dB/100 m) Max.	NEXT (dB) Min. /Typical	PSNEXT (dB) Min./ Typical	ELFEXT (dB) Min./ Typical	PSELFEXT (dB) Min./ Typical	Return Loss (dB) Min.	ACR (dB) Typical 90m	PS ACR (dB) Typical 90m
0.772	1.8	72/81	69/77	66/73	63/70	19.4	77.4	73.4
1	2.0	70/79	67/75	64/71	61/68	20.0	75.2	71.2
4	4.1	61/70	58/66	52/59	49/56	23.1	64.3	60.3
8	5.8	57/66	54/62	46/53	43/50	24.5	58.8	54.8
10	6.5	55/64	52/60	44/51	41/48	25.0	56.2	52.2
16	8.2	52/61	49/57	40/47	37/44	25.0	51.6	47.6
20	9.3	51/60	48/56	38/48	35/42	25.0	49.6	45.6
25	10.4	49/58	46/54	36/43	33/50	24.3	16.6	42.6
31.25	11.7	48/57	45/53	34/41	31/38	23.6	44.5	40.5
62.5	17.0	43/52	40/48	28/35	25/32	21.5	34.7	30.7

Frequency (Mhz)	Attenuation (dB/100 m) Max.	NEXT (dB) Min. /Typical	PSNEXT (dB) Min./ Typical	ELFEXT (dB) Min./ Typical	PSELFEXT (dB) Min./ Typical	Return Loss (dB) Min.	ACR (dB) Typical 90m	PS ACR (dB) Typical 90m
100	22.0	40/49	37/45	24/31	21/28	20.1	27.2	23.2
155	28.1	37/46	34/42	20/27	17/24	18.8	48.7	14.7
200	32.4	36/45	33/41	18/25	15/22	18.0	13.8	9.8
300	41.0	33/42	30/38	14/21	11/18	16.8	3.1	-
350	44.9	32/41	29/37	13/20	10/17	16.3	-	-

2.8.3 The horizontal interconnect for data circuits shall consist of patch cords from the horizontal communications outlet patch panels to the network equipment within the same or adjacent racks. The horizontal data interconnect shall be contained in 19”x7” racks. All equipment racks shall be augmented with horizontal and vertical management hardware, both front and rear, to properly dress horizontal cables and patch cords. Patch panels shall be 19” wide by 5.25” high and provide connectivity for sixteen 4-pair cables. Patch panels shall terminate the building cabling on 110-style card edge connectors, which will accept adapter inserts to provide the appropriate connector interface. Patch panels shall be of reconfiguring the connector interface without re-terminating the horizontal cables. Each data patch panel shall be loaded with adapter inserts that split the 4-pair cable across two modular jacks, pinned out for the intended application.

2.9 Communications Outlets

2.9.1 This covers the specifications and performance for telecommunications outlets as defined by ANSI/TIA/EIA-568B.1.

2.9.2 Outlet Characteristics General Description: The outlet shall consist of a base, snap-on removable cover and snap-in removable connector panels. The outlet shall be designed for mounting to indoor walls in areas not exposed to dripping liquids. It shall be used to terminate and protect optical and copper telecommunications cabling. The connector panels shall contain the optical fiber connector adapters and the copper jacks used to interconnect between the horizontal cabling and the work area cabling.

2.9.3 The outlet shall accept five connector panels. The connector panels shall mount in the left, right and bottom sides of the outlet. No connector panels shall come out of the topside of the outlet or out of the cover.

2.9.4 Connector panels shall be available that accept industry standard telecommunications copper jacks, singly or in multiples, depending on the form factor of the connector. When using Category 6 copper jacks, the maximum capacity of the outlet shall be ten copper jacks.

2.9.5 The outlet cover shall contain provisions for mounting a single gang device plate. The outlet cover shall not be required for installation and termination of cables unless the optional single gang device is utilized.

2.9.6 Mounting: The outlet shall mount to vertical rigid surfaces, including furniture panels.

2.9.7 Wall mounting: The outlet shall allow for mounting directly to sheet rock or concrete walls. It shall have mounting holes that allow mounting to single- and double-gang utility boxes. Each mounting hole shall be labelled with an identifying letter and the installation instructions shall list, by identifying letter, the holes to use for each mounting configuration.

2.9.8 Partition mounting: Mounting brackets shall be available that allow outlet mounting to furniture panels.

2.9.9 Other mounting: Alternate mounting kits shall be available, including double-sided adhesive tape, magnetic tape, and hook & loop fasteners.

2.9.10 Labelling:

.1 A removable paper label shall be provided that allows for user code or space identification. The label shall allow the user to write in identification information with a pencil or ballpoint pen. Replacement labels shall be available.

.2 Termination position identification, icons: Removable icons shall be available for termination position identification. These shall be available in several colors and symbols to allow user definition of the different network circuits. At a minimum, the following colors should be available: blue, yellow, red, white, electric ivory, ash, green, purple, grey and black. At a minimum, the following symbols should be available: blank, telephone, computer, category 5, video, CATV and satellite.

.3 Termination position identification, label: A permanently attached paper label shall be provided that allows for termination position identifiers. The label shall allow the user to write in termination position identifiers with a pencil or ballpoint pen.

.4 Conform with the Town of Blind River SCADA tagging convention to suit tagging and labels.

2.9.11 The outlet shall be injection molded from engineering thermoplastics. The outlet shall have a textured finish for durable and pleasing aesthetics.

2.9.12 The outlet shall be available in a variety of colors, including, at a minimum, black, white, beige and grey.

2.9.13 Connector Panels: Snap-in removable connector panels shall be available that accept standard industry fiber optic adapters and copper jacks, including duplex SC and ST fiber adapters and Category 6 copper jacks:

.1 The connector panel shall be injection molded from engineering thermoplastics.

.2 The connector panel shall be available in a variety of colors, including, at a minimum, black, white, beige and grey.

.3 Blank Panels: Blank connector panels shall be provided when adapters are not installed that totally close the individual panel opening in the outlet. These blank panels shall have cutouts for ¾” and 1” wide surface raceway.

.4 Labelling: Each panel shall be permanently marked with a letter identifier that allows verification of panel version.

2.9.14 Surface Raceway: The top surface of the outlet base shall have cut-outs for ¾", 1" and 1½" wide surface raceway. In addition, the blank connector panels shall have cut-outs for ¾" and 1" wide surface raceway.

2.9.15 Cable Strain Relief: The interior of the outlet shall contain tie-down points designed specifically for strain relieving distribution cables. A minimum of four points shall be provided.

2.9.16 Fiber Routing: The interior of the outlet base shall have a round hub for controlling the minimum bend radius of the fibers. This hub shall have fiber-retaining fingers for fiber slack retention.

2.9.17 Security: For added security, the cover of the outlet shall contain provisions for fastening the cover to the base with a screw. The head of the screw shall be hidden from view by a removable cover plate.

2.9.18 Recycling: The outlet base and cover shall be permanently marked with the date of manufacture and the name of the material used.

2.10 CAT 6 Range Extenders

2.10.1 Supply and install CAT 6 range extenders as required and approved by the Engineer for any CAT6 cable that is between 100m and 150m in length.

2.10.2 All range extenders shall be housed in an appropriately sized junction box that is weatherproofed according to installation location.

2.10.3 Range extenders shall have the following specifications (without being limited to):

.1 IEEE802.3af and IEEE802.3at compatible (at minimum)

.2 Require no additional power supply

.3 10/100/1000 Mbps half/full duplex capable

.4 RJ-45 connectors

2.10.4 Model number: IPX201 from BSD Networks or approved equal.

2.11 Tools

2.11.1 Provide the following fiber optic tools:

.1 TKT-UNICAM-CTS Continuity test kit as manufactured by Corning or Approved Equivalent.

.2 VFL-350 Visual Fault locator as manufactured by Corning or Approved Equivalent.

3 EXECUTION

3.1 General Instructions

3.1.1 The Contractor shall supply a schedule for review prior to submission of shop drawings. The schedule shall be tabular form and have a minimum of:

.1 Item system description

.2 Tag number as herein specified or as shown on the drawings.

.3 Reference to specification item number, drawing number and description

.4 Proposed submission date

.5 List of associated equipment. Note all equipment forming part of a system should be submitted at same time.

3.2 Quality Assurance Provisions

3.2.1 All backbone cabling, which this contractor terminates shall be tested to applicable TIA/EIA standards.

3.2.2 The insertion loss for each mated fibre connector pair shall be <0.75dB. Reflectance for single-mode and single-fibre UPC cable assemblies shall be <-55db. Mated connector pair loss testing shall be based on one unidirectional OTDR inspection in accordance with the OTDR operating manual for systems. In addition to connector insertion loss for each mated pair, this contractor shall perform end to end insertion loss testing for each single-mode fibres at 1310nm and 1550nm from one direction for each terminated fibre span in accordance with TIA/EIA 526-7 (OFSTP 7). For spans greater than 90 meters, each tested span must test to a value less than or equal to the value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each tested span must be <2.0 dB.

3.2.3 The cable manufacturer shall be TL 9000 registered.

3.3 Fiber Cable Vertical Runs

3.3.1 Use the following guidelines when installing cable in vertical runs:

.1 Work from the top down, when possible.

.2 Install a split wire mesh support grip at the top of each run prior to entering termination hardware or horizontal distribution.

.3 Each fibre optic cable in the vertical run needs to be supported by its own support grip at the top of the run.

.4 Never use fibre optic cables as support for other cables Cable that are individually supported may be taped or cable-tied together every three meters for cable management – not support.

.5 Install additional support grips wherever additional security is desired.

.6 Securing the cable to the riser shaft with a split-grip every six meters (20ft) is recommended in order to keep the cable in its desired location.

.7 Secure the cable in riser wiring closets with cable ties or straps as needed to prevent accidental damage to cable.

.8 Ensure that governing fire codes are maintained through the use of non-combustible tubing or fire stops at each floor.

3.4 Fiber Optic Testing

3.4.1 The fiber optic cable shall be installed, terminated, and tested by an experienced fiber optic network installer. Each fiber of each fiber optic cable shall be tested after installation. For each fiber with a length of more than 100 ft, an end-to-end power attenuation (insertion loss) test shall be performed. The attenuation test shall utilize a stabilized optical source and an optical power meter calibrated to the appropriate wavelength (850 or 1300nm).

3.4.2 For each installed fiber the power attenuation shall not exceed the values recommended by the fiber optic transceiver manufacturer. The Owner will not accept fiber optic cables containing one or more fibers not meeting this performance. Cable shall be repaired or replaced. All necessary hardware, test equipment, cables and test meters, required for the testing shall be provided. The results of the fiber optic cable testing shall be documented and submitted to the Engineer.

3.4.3 The contractor shall use his own test equipment, which shall bear current calibration certification from a certified instrument calibration laboratory.

3.4.4 Upon completion and testing of the installed cabling system, test reports shall be submitted to the engineer in printed form, in duplicate. Test reports are to show all field tests performed to prove compliance with the specified performance criteria. Date of calibration of the test equipment is also to be provided.

3.4.5 Provide Manufacturer Test Documentation. Test documentation from the fiber optic cable manufacturer to the job site, is a prerequisite for cable installation.

3.4.6 The test documentation shall include Optical Time Domain Reflectometer (OTDR) traces for each fiber of each reel at 1300nm and 1550nm. Optical attenuation test data shall be furnished for each fiber of each reel, as measured at 1300nm and 1550nm.

3.4.7 The contractor shall test the fiber optic cable prior to and after its installation. The Engineer shall witness this testing.

3.4.8 All strands are to be terminated to facilitate testing. This applies to strands that will be in use as well as those being left dark. All connectors shall be visually inspected for scratches, pits or chips and shall be re-terminated if of these conditions exist.

3.4.9 Testing shall consist of making an OTDR trace of each fiber of each reel, at both 1300 nm and 1550nm while on the reel and for all installed fiber runs over 200 feet. The test shall incorporate a 1-km long backscatter suppression cable inserted between the OTDR and the fiber end. Each trace shall include the optical length and average attenuation. Traces are to be performed from one end of each fiber. The scale of the OTDR trace shall be such that the entire circuit appears over as much of the X-axis as possible. If available, OTDR traces are to be submitted on disk as well as printed.

3.4.10 Power meter and light source tests are to be done on all terminated fiber. Each run shall be tested for insertion loss at 1300 and 1550nm. Fiber must perform at (or better) than FDDI standards.

3.4.11 Any cable that shows out-of-spec performance shall be replaced at no addition cost.

3.5 Packing and Shipping of Fiber

3.5.1 When storing fibre cable, both ends of the cable shall be sealed to prevent the ingress of moisture.

3.5.2 Never store, ship or lay a reel of fibre cable on its side.

3.6 Termination of Fiber Strands

3.6.1 All strands of each fibre cable installed must be terminated both ends in the appropriate patch panel whether the fibre is used or not.

3.6.2 All terminations and patch cords must be tested using OTDR by a qualified technician. Results of testing must be submitted to the Engineer.

3.7 Supervision and Commissioning

3.7.1 The Contractor shall retain his supplier to thoroughly check the final installation and performance of each individual piece of equipment. The work shall also include site supervision of the installations where necessary, repair and adjustments to the suppliers' equipment, and co-ordinate the field supervision by other suppliers and the Contractor within their areas of responsibility.

3.7.2 Coordinate start-up and testing with the automation equipment and control system supplier specified in Division 13 – Instrumentation, Control and SCADA.

3.7.3 Non-Operational Tests – on site:

.1 Verify all communication links

.2 Demonstrate existing Fiber, new and existing Ethernet communications between the respective locations

3.7.4 Operational Tests – on site:

.1 The Contractor shall provide these services for the installing network and the services of the communication controls technician on site for a period of not less than seven non-consecutive days during start-up and commissioning and witness testing. Changes or adjustments to field wiring and configuration shall be at no cost.

3.8 Installation of Communication Control Panels or Network Cabinets

3.8.1 Provide all necessary labour, equipment, tools, anchor bolts, etc., to provide the complete installation of all equipment under this division.

3.8.2 Installation location to be approved by the Engineer.

3.8.3 Install all equipment in a workmanlike manner and in accordance with the manufacturer's drawings, instructions and under direction of his qualified technical representative unless otherwise specified or instructed by the Engineer.

3.8.4 Provide and install all lubricants necessary for initial operation of equipment in accordance with manufacturer's instructions unless otherwise specified.

3.8.5 All IT panels to be wall mounted.

3.8.6 All communication network racks to be floor mounted.

3.8.7 The Contractor to remove and relocate existing light fixtures etc., in order to install the new communication control panels.

3.8.8 Existing PLC automation and communications networks must remain in service for the duration of the contract. This Contractor must obtain written approval from the Engineer and owner prior to tying in new IT Panels into the existing communications network.

3.8.9 Existing automation networks must remain in service for the duration of the project.

3.8.10 Supply and install a fiber patch panel in the respective control panels as required.

3.8.11 The Contractor must provide seven days advanced notice of the IT panels' tie in once written approval is received.

END OF SECTION

DIVISION 14 – CONVEYING EQUIPMENT

Section No.	Title
14310	Hoists

1 GENERAL

1.1 Intent of Section

1.1.1 This section covers supply, delivery, supervision of installation and commissioning of hoist systems and related accessories.

1.1.2 The Contractor is responsible for overall coordination of the hoist equipment package, together with monorail beam, to avoid interference with proposed equipment and structures, including hangers and galvanized steel support frames.

1.2 Related Sections

1.2.1 DIVISION 1 – GENERAL REQUIREMENTS

1.2.2 DIVISION 3 – CONCRETE

1.2.3 DIVISION 13 – INSTRUMENTATION AND CONTROL

1.2.4 DIVISION 15 – MECHANICAL

1.3 Operating Conditions

1.3.1 The following site operating and water quality conditions must be assumed for all design calculations:

.1 40ºC maximum/5ºC minimum ambient air temperature.

.2 95 percent maximum relative humidity (non-condensing).

.3 Fully enclosed facility.

1.3.2 Refer to the contract drawings for further details.

1.4 Reference Standards

1.4.1 ASME HST-2-23 – Performance Standard for Hand Chain Manually Operated Chain Hoists

1.4.2 ANSI MH 27.1-09 - Specifications for Under Hung Cranes and Monorail Systems

1.4.3 ANSI B30.11-10 Monorails And Underhung Cranes - Safety Standard For Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, And Slings

1.4.4 ASME B30.16-22 – Overhead Underhung And Stationary Hoists

1.4.5 ASME B30.17-20 – Cranes and monorails (with underhung trolley or bridge)

1.4.6 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

1.4.7 ASTM F3125-23 – Standard Specifications for High Strength Structural Steel Bolts, and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength

1.4.8 CISC Design Guide – Crane-Supporting Steel Structures, 4th Edition, 2021.

1.4.9 CSA B167-16(R2021) – Overhead cranes, gantry cranes, monorails, hoists and jib cranes

1.4.10 CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

1.4.11 CSA S16-19 – Design of Steel Structures

1.4.12 CSA W47.1-2019 - Certification of Companies for Fusion Welding of Steel Structures

1.4.13 CSA W59-18 – Welded Steel Construction

1.4.14 Crane Manufacturer's Association of America (CMAA)

.1 Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist – No. 74 (2020

.2 Ontario Occupational Health and Safety Act and Regulations Part 1926.554 – Overhead Hoists

1.4.15 Ontario Building Code 2024

1.5 Submittals

1.5.1 Submit the shop drawings in accordance with Section 01330 – Submittal Procedures.

1.5.2 Provide sufficient detail to show the general construction pertinent to the proper review of the equipment. Description of the materials of construction of the major components, including:

.1 General assembly drawings of trolleys, hoists and other major components.

.2 Details of monorail beams, hangers/connectors, switches, suspension fittings, safety stops, bumpers and all required connections.

.3 Hoist hook travel range and lifting range

.4 Indicate design forces/reactions forces induced by the operation of the hoist.

.5 All drawings and other documentation to be signed and sealed by a Professional Engineer registered in the Province of Ontario.

1.5.3 The Supplier shall indicate a list of spare parts that they recommend be purchased and individual prices for each item.

1.5.4 All ancillary equipment to be provided by the Supplier shall be listed.

1.5.5 Special accessories or tools for the adjustment or removal of parts required for any piece of equipment shall be listed and furnished as part of the supply.

1.5.6 Submit installation manuals before shipping equipment.

1.5.7 Submit certified test results of load tests for hoists.

1.5.8 Submit Operating and maintenance manual.

1.6 Warranty

1.6.1 Provide manufacturer's warranty for a period of five (5) years. Warranty period to begin upon hoist and trolley final acceptance. Warranty covers defects in materials and workmanship. Damage due to ordinary use, vandalism, improper or insufficient maintenance, misuse or neglect do not constitute defective material or workmanship.

1.7 Qualifications

1.7.1 Supplier shall have a minimum of five (5) years of recent manufacturing experience in the hoist, crane and monorail business.

1.8 Maintenance Data

1.8.1 Refer to Section 01780 – Closeout Procedures.

1.9 Measurement and Payment

1.9.1 Work outlined in this section is included in the lump sum tender price.

1.10 Storage

1.10.1 The equipment and accessories shall be stored indoors in a dry area in accordance with the manufacturer's recommendations.

2 PRODUCTS

2.1 General

2.1.1 Provide three (3) complete hoist systems for the pumping station as shown on the drawings. Each system shall include the monorail beam, and related connection brackets, underhung trolleys and lifting hoists. The characteristics of the hoist system are described in the table below.

Service	**General Use**
Capacity	**1 pcs 1.5 Tonnes**
Overall length	**6.8 m**
Elevations	High hook: 183.450 Low hook: 179.950 Underside of Monorail beam: 183.450
Trolley	**Geared, hand chain operated**
Hoist	**Hand chain hoist, geared, mechanical brake**
Minimum Speed	**Hoist – 9.6/1.2 M.P.M.** **Trolley – 12/4 M.P.M.**
Deflection Limits	**Span/500 for vertical and span/360 for horizontal**
Importance Category:	**Post-Disaster**

Note: lengths and elevations in these tables are for reference purpose only. Contractor will confirm the monorail lengths and elevations per selected products in construction phase.

2.1.2 (2) monorails in the screen area and one (1) of the monorails in the pump area as shown on the drawings.

2.1.3 The support system for connecting the monorail beams to the support steel frames to be designed by a Professional Engineer registered in the Province of Ontario. Shop drawings of support system are be sealed. These shop drawings will not be checked by the Engineer for structural capacity.

2.1.4 Provide support members to hang from the underside of the support steel frames.

2.1.5 Refer to the drawings for length of monorail systems and stops.

2.2 Materials

2.2.1 Structural Steel W or S Shapes: conform to CSA G40.21, Grade 350W.

2.2.2 All bolts, nuts and clamps to satisfy F3125 galvanized as per ASTM A123..

2.2.3 The snap-in hanger clamps shall be made from a plastic material, comes with stainless steel bolts, nuts and washers.

2.2.4 Provide all required expansion joints, anchor clamps, end caps and hanger clamps.

2.2.5 All monorail beams, brackets, end stops to be epoxy printed. Hoist to have an epoxy primer, intermediate and top-coat as recommended by the manufacturer.

2.3 Design Requirements

2.3.1 Design and construct the monorail beams from standard I-beam or wide flange beam.

2.3.2 Design the load-carrying flanges to not be stressed in excess of the values set forth in the Monorail Manufacturer's Association Specifications for the under hung crane and monorail system.

2.3.3 If load conditions require, shop fabricate track by combining monorail with other structural steel shapes welded into an integral beam.

2.3.4 Design the support system for connecting the monorail beams to steel support frames.

2.3.5 Provide all suspension fittings. Include all structural steel hangers, intermediate structural steel hangers, braces and all connection hardware.

2.3.6 Provide adequately sized fabricated steel fittings for the indicated loads.

2.3.7 Provide proper bracing to prevent movement of rail beams during operation.

2.4 Safety Stops and Bumpers

2.4.1 Fit all open ends of the monorail beams with safety stops or bumpers to prevent trolleys from running off the ends or hitting walls or other building features.

2.5 Bolts, Nuts and Clamps

2.5.1 Provide all bolts and nuts, grade ASTM A325 galvanized.

2.6 End Trucks, Trolleys and Hoists

2.6.1 The hoisting mechanism shall consist of a winding drum and reduction gearing.

2.6.2 The winding drum shall be accurately machined to contain the hoist rope in a single layer. Not less than 2-1/2 spare turns of rope to remain on the drum when the hoist rope is fully extended.

2.6.3 Hoist to be provided with an extra flexible,steel wire rope.

2.6.4 To ensure correct rope reeving during operation, a rope guide and pressure ring shall be provided.

2.6.5 The lower hook shall come with a safety latch.

2.6.6 Trolley shall be of the articulated design to allow smooth travel around curves.

2.6.7 Trolley frame shall be a weldment of structural steel.

2.6.8 Wheels shall resist wear, be mounted on anti-friction bearing and guide rollers shall be provided for each trolley.

2.6.9 The hoist and trolley shall be CSA certified.

2.6.10 Provide bumpers on the ends of trolleys to prevent damage to the wheels.

2.7 Grease Fittings

2.7.1 Pipe lubrication points on the trolley and hoists to a convenient location and terminate them in grease nipple fittings to facilitate servicing.

2.8 Lifting Shackles

2.8.1 Provide lifting shackles for each assembly rated for the service intended.

2.9 Monorail Hoists

2.9.1 Provide manual monorail hoists with cadmium plated lifting chain and chain container or cable.

.1 Provide one (1) manual chain hoist for lifting 1500 kg.

.2 Provide two (2) manual chain hoist for lifting 1000 kg.

2.10 Capacity Nameplates

2.10.1 Provide stick-on or painted nameplates indicating crane capacity.

2.11 Acceptable Manufacturers

2.11.1 Equipment must be supplied from one of the following acceptable manufacturers:

.1 Kone Crane

.2 Zelus Material Handling

.3 Stahl CraneSystems Inc.

.4 Columbus McKinnon Corporation

.5 RWS Hoist and Cranes Inc.

.6 Liftsafe Engineering and Service Group Inc.

.7 Approved equivalent

2.11.2 Devices whose manufacturer does not have substantiated test data from at least three (3) recognized and independent hydraulic testing facilities for exact design being provided, such as ASME meters, shall not be allowed.

3 EXECUTION

3.1 Installation and Inspection

3.1.1 The hoist and monorail systems shall be installed as indicated on the Contract drawings, in accordance with the manufacturer’s recommendations and, as approved by the Engineer.

3.1.2 Provide the services of a factory-trained representative to inspect, operate, test, adjust and trouble-shoot the installation.

3.1.3 Provide and install all lubricants and liquids necessary for initial operation of the equipment.

3.1.4 Inspection to include checking for:

.1 Cracks and other damaged or defective parts. Each monorail system, as well as accessories, must be undamaged, without cracks and free of defective parts.

.2 Completeness of installation as specified and as recommended by the manufacturer.

.3 Correctness of setting, alignment and relative arrangement of various parts of the system.

3.1.5 Provide for additional supervision of installation by equipment supplier as required.

3.1.6 Arrange with the Engineer a mutually agreeable date when the representative should be on site.

3.1.7 Submit a report, signed by the manufacturer's representative, describing in detail the inspection, tests and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verify that the equipment conforms to all specifications.

3.2 Mechanical Testing and Certification

3.2.1 After start-up and prior to final acceptance, the Contractor shall conduct engineer-witnessed performance tests on the equipment.

3.2.2 The field service representative will cause the hoist and monorail mechanism to perform all mechanical functions that the mechanism is designed to perform. Tests will be scheduled with the Engineer at least two (2) weeks prior to the planned test date.

3.2.3 The field service representative shall submit to the Engineer a written report stating that the equipment has been checked and is suitable for operation.

3.3 Supervision of Installation and Commissioning

3.3.1 Test and commission the equipment in accordance with Section 01810 – Testing and Commissioning.

3.3.2 At the completion of satisfactory installation, each unit shall be started by the General Contractor under the supervision of the Supplier and in conjunction with plant operating conditions. All controls and alarms shall be checked and tested to ensure proper control and equipment protection.

3.3.3 Equipment shall only be accepted after receipt of a satisfactory report submitted by the manufacturer's representatives.

3.3.4 Modify or replace equipment or materials failing required tests.

3.3.5 Perform additional testing required, due to changes of materials and/or failure of materials or construction, to meet specifications at no extra cost to the Owner.

3.4 Testing

3.4.1 Submit certified test results of load tests for the hoists and the complete crane system.

3.4.2 Test all equipment after installation in the presence of the Engineer to verify that it meets the stated specifications, local codes and Ministry of Labour requirements.

3.4.3 After installation has been completed and before being placed into service, the hoist system shall be operated and tests carried out to provide the following:

.1 All clearances and alignments are in order.

.2 All protective devices operate satisfactorily.

3.4.4 After the above has been completed, the hoist system will be tested with the hook carrying:

.1 Rated load: during these tests, the specified speed need not be attained but the equipment shall show itself capable of dealing with the overload without difficulty.

.2 After 25 percent overload: during this test, the specified speed need not be attained but the equipment shall show itself capable of dealing with the overload without difficulty.

.3 After the 25 percent overload test: the hoist overweight limit switch shall be readjusted so the hoist will cut out at a ten percent overload.

.4 All test weights and slings shall be provided.

.5 Where the equipment does not meet the specifications, it is to be revised, replaced or readjusted to the satisfaction of the Engineer until it does meet the specifications.

.6 A written test report shall be sent to the Engineer and be included in the maintenance manual.

3.5 Maintenance

3.5.1 Provide maintenance on Supplier's material, as required by the Supplier, from the date of delivery to the initial start-up.

END OF SECTION

DIVISION 15 – MECHANICAL

Section No.	Title
15010	Mechanical General Requirements
15020	Systems Verification
15043	Balancing
15044	Commissioning
15090	Supports, Anchors and Seals
15100	Basic Materials and Methods
15170	Meters and Gauges
15184	Refrigerant Piping
15260	Thermal Insulation for Piping
15270	Thermal Insulation for Ductwork
15305	Portable Fire Extinguishers
15401	Plumbing General
15412	Domestic Water Supply Piping
15413	Drainage, Waste and Vent Piping
15430	Plumbing Specialties and Accessories
15440	Plumbing Fixtures and Trim
15450	Plumbing Equipment
15760	Electric Heaters
15770	Room Air Conditioning Units
15810	Ductwork and Accessories
15820	Air Distribution Equipment
15900	HVAC Controls
15955	Piping Leakage Testing

1 GENERAL

1.1 Scope

1.1.1 Carefully read and comply with the Instructions to Bidders, the General Conditions of the Contract, Supplementary Conditions and the requirements of Division 1.

1.1.2 Section 15010 applies to and governs all work of Division 15.

1.1.3 Refer to Instructions to Bidders and/or Supplementary Conditions for instructions regarding taxes, including the Ontario Provincial Retail Sales Tax (PST) and the Federal Goods and Services Tax (GST).

1.1.4 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among subcontractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish subcontract limits between any Sections of the work.

1.2 Description

1.2.1 Work Included

.1 Provide labour, materials, plant equipment, and incidentals necessary to completely supply, install, test and put into operation all mechanical work indicated under this Division.

.2 Provide identification of equipment, piping, ductwork, and valves and controllers.

.3 Provide concrete equipment bases and housekeeping pads. Refer to Division 3 for requirements.

.4 Provide motors required for equipment supplied under this Division.

.5 Provide internal wiring, relays, contactors, switches, transformers, motor starters, and all controls necessary for the intended operation, furnished with terminals and external controls suitable for connection to power source at a single easily accessed location for equipment items that are supplied with motors and/or electrical or electronic components under this Division.

.6 Each Section shall take such measures and include in Bid Price for the proper protection of the building and its finishes at all times during construction. Coordinate this protective work with all trades.

.7 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval prior to starting and/or returning to operation.

1.2.2 Related Work

.1 Power wiring, conduit and connections for motors under this Division will be by Division 16.

.2 Flashings for mechanical equipment and services located on or passing through roofs will be provided under Division 7. Supply counter flashings, integral flashings, and integral flashing collars on equipment and piping under this Division.

.3 Painting of exposed piping and ductwork other than for identification will be supplied under Division 9. For painting under Division 15, refer to paragraph 3.2.6.

.4 The Controls Sub-Contractor under Section 15900 will require 120 volt power for certain components of his system. As part of his work he will obtain power from the nearest branch panel as site directed by the Consultant and supply and install his own properly sized breaker. His work will be done to the same standards as specified in Division 16.

1.3 Intent

1.3.1 Provide products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.

1.3.2 The specifications are integral with the drawings which accompany them. Neither is to be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.

1.3.3 Wherever differences occur in the tender documents, the most onerous condition governs. Base the bid on the costliest arrangement.

1.4 Submittals

1.4.1 Approval Drawings: Prepare and submit drawings necessary for approval to any authority having jurisdiction and obtain two (2) copies of approved drawings for retention by Consultant prior to commencement of work under this Division.

1.4.2 Shop Drawings:

.1 Prepare and submit shop drawings of major equipment items electronically (including those items specifically indicated under Part 1: General of each Section), to the Consultant for review. The Consultant will return an electronic copy, marked with comments and his review stamp as he deems appropriate. Prepare the necessary number of copies of the returned set and distribute to the Owner, the Prime Consultant, the General Contractor, the site, and to subcontractors and suppliers.

.2 Clearly indicate manufacturer's and supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities and performance. Prior to submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by Consultant, has been returned to Contractor.

.3 Clearly indicate the weight, location, method of support and anchor point forces and locations for each piece of equipment on shop drawings.

.4 The Consultant will not review shop drawings not bearing the Contractor's stamp of approval or certification.

.5 Read the following in conjunction with the wording on the shop drawing review stamp applied to every drawing submitted:

.1 "This review by the Consultant is for the sole purpose of ascertaining conformance with general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub trades."

1.4.3 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they conform to the requirements of those documents (e.g., NFPA-standards). Include a copy of each certificate in the Operation and Maintenance manual. Certificates shall include the following:

.1 Description of the system (description and type),

.2 Description of the tests conducted, and results observed, including re-testing, where necessary,

.3 Description of any corrective measures undertaken,

.4 Description of materials used (pipe and fittings),

.5 List of witnesses for each test conducted,

.6 Date system left ready for service,

.7 Signature of installing contractor.

1.4.4 Directories & Schematics

.1 Submit five (5) copies of a neat typewritten directory indicating the valve number, related service, and location of each valve under this Division.

.2 Submit five (5) copies of system control schematics for each mechanical system indicating relative locations of equipment and control devices.

.3 Enclose one (1) copy of each directory/schematic under glass in a neat polished 460 mm x 610 mm (18" x 24") metal frame, complete with mounting clips.

1.4.5 Maintenance Data and Operating Instructions

.1 Submit three (3) copies of Operation and Maintenance Manual individually bound in hard backed three-ring binders.

.2 Ensure the binder spines have typewritten lettering as follows:

MECHANICAL

OPERATION & MAINTENANCE MANUAL

FOR

[Insert Project Title]

[Insert date of submission]

.3 Provide a master index at the beginning of each binder indicating items included. Use plastic tab indices for all sections of the manual with separate sections for each different type of equipment item.

.4 Provide a list of names, addresses and telephone numbers of equipment suppliers, installing contractors, general contractors, architect, and Consultant. Include special telephone numbers for service departments on normal and emergency call basis.

.5 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item.

.6 Include copies of start-up reports and checklists and all certificates issued with respect to this contract.

.7 Ensure operating instructions include the following:

.8 General description of each mechanical system.

.9 Step by step procedure to follow in putting each piece of equipment into service.

.10 Schematic control diagrams for each separate mechanical system, control panel, etc. Each diagram shall indicate locations of start-stop switches, insertion thermostats, thermometers, freezestats, firestats, pressure gauges, automatic valves, and refrigeration accessories. Mark correct operating settings for each control device on these diagrams.

.11 Diagram of the electrical control system indicating the wiring of all related electrical components such as PE and EP switches, firestats, freezestats, fuses, interlocks, electrical switches, and relays.

.12 Drawings of each control panel including temperature control and electrical panels, completely identifying all components on the panels and their function.

.13 Ensure maintenance instructions include the following:

.1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts numbers and lists, name of supplier and maintenance and lubrication instructions.

.2 Summary list of each item of mechanical equipment requiring lubrication, indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.

.3 Equipment directory indicating name, model, serial number and nameplate data of each item of equipment supplied, and system with which it is associated.

.4 Balancing and testing reports.

.5 Copy of valve directory.

1.4.6 As-Built Records: Prepare and submit complete as-built records prior to Substantial Performance of the Contract. Refer to Division 1 for additional requirements.

1.4.7 Requests for Shut-Down: Obtain permission for systems shut-down and/or service interruption from the Owner prior to disruption of any system or service in use by the Owner. Employ the Owner's standard form of request where available. Refer to Division 1 for additional requirements.

1.4.8 Requests for Start-up: Obtain permission from the Owner to start-up or to return to service any item of equipment, system or service installed new or previously shut-down. Refer to Division 1 for additional requirements.

1.5 Quality Assurance

1.5.1 Conform to minimum requirements or better of provincial and local codes, where existing, and to requirements of local inspection authorities for execution of work under this Division.

1.5.2 Ensure materials supplied under this Division conform to minimum requirements and recommendations or better of applicable standards of the following:

.1	AABC	Associated Air Balance Council
.2	AMCA	Air Moving and Conditioning Association
.3	ANSI	American National Standards Institute
.4	ASA	American Standards Association
.5	ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
.6	ASME	American Society of Mechanical Engineers
.7	ASSE	American Society of Sanitary Engineers
.8	ASTM	American Society of Testing and Materials
.9	AWWA	American Water Works Association
.10	CAN2	National Standard of Canada (Published by CGSB)
.11	CAN3	National Standard of Canada (Published by CSA)

.12 CGA Canadian Gas Association

.13 CGSB Canadian General Standards Board

.14 CSA Canadian Standards Association

.15 EEMAC Electrical & Electronic Manufacturer's Association of Canada

.16 NEBB National Environmental Balancing Bureau

.17 NBC National Building Code of Canada

.18 NFPA National Fire Protection Association

.19 SMACNA Sheet Metal & Air Conditioning Contractors National Association Inc.

.20 ULC Underwriter's Laboratories of Canada Ltd

1.5.3 Use latest editions and amendments in effect on date of Bid call.

1.5.4 Arrange and pay for permits and inspections by authorities having jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.

1.5.5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or Owner when requested.

1.5.6 All refrigeration work shall be executed only by mechanics with valid ODP cards.

1.6 Product Delivery, Handling and Storage

1.6.1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.

1.6.2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

1.7 Job Condition

1.7.1 Visit site and examine existing conditions which may affect work of this Division.

1.7.2 Examine all Contract Documents to ensure that work of this Division may be satisfactorily completed.

1.7.3 Notify Consultant upon discovery of conditions which adversely affect work of this division. No allowance will be made after letting of contract for any expenses incurred through failure to do so.

1.7.4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications unless exceptions are specifically noted in the Bid.

1.8 Warranty

1.8.1 Refer to General Conditions. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.

1.8.2 Make submissions necessary to register product warranties to the benefit of the Owner.

1.8.3 Submit to Consultant, prior to Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one (1) year or offering greater benefits than required in specifications and in the Owner's name.

1.9 Definitions

1.9.1 The following are definitions of words found in this specification and on associated drawings under this division:

.1 "Concealed" hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.

.2 "Exposed" mechanical work normally visible to building occupants.

.3 "Provide" (and all tenses of "provide") - supply, install and connect complete.

.4 "Install" (and all tenses of 'install") - install and connect complete, products and services specified.

.5 "Supply" supply only.

.6 "Owner" building Owner as defined in the Contract or the Owner's designated representative.

.7 "Consultant" the Consultant as defined in the Contract and/or a Sub-Consultants retained by the Consultant.

.8 "Wet" wet areas requiring special materials. Where indicated on drawings and/or specified herein. Includes pool, whirlpool, shower areas, etc.

1.9.2 Protection: protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under this Division. Repair to satisfaction of Consultant, damage to building resulting from failure to provide such protection.

1.9.3 Connections: include in Bid price amounts required by municipality and/or utilities for connection of water, sewer, and natural gas services. Ensure amounts include fees, assessments, charges, etc., required in relation to service connection. Do not include acreage or frontage charges.

2 PRODUCTS

2.1 Materials and Equipment

2.1.1 Ensure materials and equipment provided under this Division are new and free from defects and bear labels of approval as required by codes referred to in this Division and/or by inspection authorities.

2.1.2 Ensure apparatus and equipment provided under this Division bears manufacturer's nameplate indicating name of manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.

2.1.3 Ensure manufacturers and suppliers of equipment or materials under this Division determine if their products are composed of any hazardous materials. If they are, the products are suitably labeled and supplied with Material Safety Data sheets. Obtain the Owner's approval in writing to bring hazardous materials onto the site prior to doing so.

2.1.4 When utilizing any products that are hazardous, keep Material Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

2.2 Acceptable Products

2.2.1 First item named or specified by catalogue number meets specifications regarding performance, quality of material and workmanship, and is acceptable to the Consultant.

2.2.2 Items, other than first named, meeting specifications regarding quality of materials and workmanship are acceptable to the Consultant, only, if they also meet performance and/or capacities specified and can be accommodated within the space allotted.

2.2.3 General approval indicated by inclusion of other manufacturers named is subject to final review of shop drawings, performance data and test reports.

2.3 Equivalents and Alternatives

2.3.1 Suppliers wishing approval for additional equipment items as equivalent to those specified must submit complete description, technical and performance data to Consultant at least ten (10) working days prior to Bid closing date. Such equivalent equipment, if accepted, to conform to specifications regarding all details, accessories, modifications, features, and performance. Deviations from specifications must be stated in writing at time of submission for approval.

2.3.2 Bid Prices shall include only products specified or approved equivalents. Contractors may propose unsolicited alternatives to the products specified. Alternative proposals shall be submitted in sealed envelope at time of general contract Bid submission and shall include full description and technical data, and a statement of the related increase or decrease in Bid Price should alternatives be accepted. All additional costs associated with unsolicited alternative proposals such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in alternative price. Prior approval by Consultant is not required for unsolicited alternative proposals.

2.3.3 Where Contractor uses equipment other than that first named, on which the design is based, he shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in Bid Price.

2.3.4 Substitutions During Progress of Work;

.1 If during the progress of work, specified products are not obtainable, equivalent or similar products by other manufacturers may be permitted by Consultant.

.2 Apply, in writing, to Consultant for substitution of any products, indicating the following:

.1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities, and performance of proposed products.

.2 Reason for substitution.

.3 Any revisions to the contract price made necessary by substitution.

.4 Any revisions to the contract time made necessary by substitution.

.3 Any revisions to layout, arrangement or services made necessary by substitution.

.4 No substitutions will be permitted without written authorization from the Consultant.

2.4 Consultant's Review

2.4.1 The consultants will review and evaluate unsolicited alternatives and substitutions proposed by the Contractor. Such review and evaluation work will be undertaken by the Consultant on an additional fee basis. The Contractor shall reimburse the Owner for all costs associated with such reviews and evaluations.

2.4.2 The Contractor shall also reimburse the Owner for all costs incurred in updating Contract Documents to reflect such changes.

2.4.3 Refer to Division 1.

3 EXECUTION

3.1 Inspection

3.1.1 Inspect installed work of other trades and verify that such work is complete to point where work under this Division may properly commence.

3.1.2 Verify that work of this Division may be executed in accordance with pertinent codes and regulations, specifications, drawings, and referenced standards.

3.1.3 Review drawings and verify dimensions at the site. Report discrepancies immediately to Consultant before proceeding with any construction work or shop drawings.

3.2 Installation, Application and Performance

3.2.1 Relationship With Other Trades

.1 Cooperate with other trades whose work affects or is affected by work of this Division to ensure satisfactory installation and to avoid delays.

.2 Provide materials to be built-in, such as sleeves, anchors, and inserts, together with templates and/or measurements, promptly when required by other trades.

.3 Provide structural supports for equipment to be mounted on or in walls, supported above floors and/or suspended from the structure.

3.2.2 Installation Requirements

.1 The Consultant's drawings and instructions govern the location of all items. Prepare fully coordinated installation drawings prior to installation.

.2 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.

.3 Confirm the exact location of outlets, fixtures and connections. Confirm location of outlets for equipment supplied under other divisions.

.4 Install equipment and apparatus to allow free access for maintenance, adjustment, and eventual replacement.

.5 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.

.6 Provide suitable shielding and physical protection for devices.

.7 Install products and services in accordance with the manufacturer's requirements and/or recommendations.

.8 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.

.9 Do not use power activated tools without written permission of the Consultant. Use them in accordance with the Owner's health and safety policies.

.10 Ensure that the load onto structures does not exceed the maximum loading per square metre indicated on the structural drawings or as directed by the Consultant.

3.2.3 Contract Drawings

.1 The drawings of this Division are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given.

.2 Obtain accurate dimensions from the architectural and structural drawings, or by measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.

.3 Make changes where required to accommodate structural conditions, (beams, columns, etc.). Obtain Consultant's approval before proceeding.

.4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not

affect material quantity. Note that outlets and/or equipment may be relocated up to 3m (10 feet) in any direction without a change to the contract price.

.5 Note that the layout and orientation of the ceiling outlets on the architectural reflected ceiling drawings may differ from that shown on the mechanical drawings. Make the installation in accordance with the latest architectural ceiling drawings. Provide the equipment as specified and/or shown on the mechanical documents.

.6 The mechanical drawings are intended for tender pricing. The quantities and quality to be included in the bid price shall be based on the layout and specifications as shown on the mechanical documents. If there is a difference in quantity between the architectural and mechanical drawings, base the contract price on the greater quantity.

.7 Prepare installation (construction) drawing to reflect the latest architectural ceiling layout.

3.2.4 Record Drawings

.1 Refer to Division 1 for additional requirements.

.2 Maintain project "as-built" record drawings. Obtain white prints from the Consultant for this purpose and pay printing costs. Identify each set as "Project Record Copy".

.3 Record deviations from contract documents caused by site conditions or by changes ordered by the Consultant. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of Consultants documents.

.4 Record deviations as work progresses throughout the execution of this contract. Maintain record drawings on site in clean, dry, legible condition, making them available for periodic review by the Consultant.

.5 Record location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.

.6 Transfer records from the "Project Record Copy" to a computer file on compact disc in AutoCAD format. Arrange computer file in layers to exactly match the layering system of the Consultant.

.7 Submit the "Project Record Copy", the computer diskettes with a plot of each drawing on velum transparency and two sets of white prints taken from the vellums to the Consultant at Substantial Completion.

3.2.5 Cutting and Patching

.1 Include cutting and patching as required in execution of work under respective sections of this division.

.2 Holes through the structure will not be permitted without written approval of the Consultant. All openings required through the completed structure must be clearly and accurately shown on a copy of the relevant structural drawing(s). Exact locations, elevations and size of the proposed opening must be identified well in advance of the need for the work.

.3 All sleeved or formed openings through the structure must be shown on sleeving drawings and must be approved by the Structural Engineer prior to construction.

.4 Reinforcing shall not be cut or modified without prior approval of the Structural Consultant. Should reinforcement be cut without such prior approval, the cost of any additional reinforcement deemed necessary by the Structural Consultant shall be the responsibility of this Contractor.

.5 Alternative imaging techniques are subject to the approval of the Structural Consultant.

.6 Ensure that cutting and patching of roofs and reinforced concrete structures is executed by specialists familiar with the materials affected and is performed in a manner to neither damage nor endanger the work. Coordinate and supervise such cutting and patching.

.7 Make good surfaces affected by this work and repair finish to satisfaction of Consultant. Finish painting, where required, will be provided under Division 9.

3.2.6 Painting

.1 Repair minor damage to finish of equipment with standard factory applied baked enamel finish under the appropriate Sections of this division. Replace entirely, items suffering major damage to finish if too extensive to be repaired in the opinion of the Consultant.

.2 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.

3.2.7 Electrical Components and Wiring

.1 Ensure Electrical components and wiring provided as part of the work of Division 15 conform to requirements and standards of Division 16. Refer to Division 16.

3.2.8 Protection: protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under this Division. Repair to satisfaction of the Consultant, damage to building resulting from failure to provide such protection.

3.2.9 Support and Attachment: support and attach piping, ductwork fixtures and equipment from load bearing structures such as beams, joists, reinforced concrete slabs and concrete block walls, and do not support from or attach to steel roof deck and/or wall or ceiling finishes.

3.3 Use of Equipment

3.3.1 For the duration of this contract, do not use any piece of equipment provided under this contract for the purposes of heating, ventilation, or air conditioning without the specific authorization of the Owner and Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to commence.

3.4 Preparation

3.4.1 Existing services and equipment shall be relocated or removed to suit new construction and renovation work.

3.4.2 Services that are no longer required shall be removed or cut back and capped as indicated to the satisfaction of Consultant.

3.4.3 Obtain written authorization from Consultant for renovation work that is not specifically indicated.

3.5 Field Quality Control

3.5.1 Temporary and Trial Usage

.1 Allow the Owner the privilege of temporary and trial usage of installed equipment, as soon as work is complete, for a period of time required to conduct a thorough test.

.2 Do not construe such usage as evidence of acceptance of work by Owner.

.3 Repair damage to work tested, resulting from such trial usage, by this Contractor at no cost to Owner.

3.5.2 Systems Verification

.1 Verify the correct installation and proper operation of equipment and systems installed. Adjust and balance each system as necessary to achieve optimum operation of each system.

3.6 Adjust and Clean

3.6.1 Clean equipment and fixtures, lubricate mechanical equipment installed under this Division and leave items in perfect order ready for operation.

3.6.2 Test and adjust control devices, instrumentation, relief valves, dampers, etc., installed in this Division after cleaning of systems and leave in perfect order ready for operation.

3.6.3 Remove from the premises upon completion of work of this division, debris, surplus, and waste materials resulting from operations.

3.7 Extras and Credits

3.7.1 Accompany price submissions for extra work, or work to be deleted, requested by Consultant, by a complete cost breakdown as follows:

.1 Materials, quantities, and unit costs including any applicable contractors trade discount clearly identified.

.2 Labour hours and unit costs.

.3 Total materials and labour costs.

.4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

3.8 Instruction

3.8.1 Instruct and familiarize Owner's operating personnel with the various mechanical systems. Arrange instruction for each system separately.

3.8.2 Provide instruction for each system on two separate occasions, coordinated with the Owner's staff operating schedule, in order that interested personnel may arrange to attend.

3.8.3 Ensure each instruction period includes, but is not limited to the following:

.1 A classroom seminar with operating manuals, product and system drawings and such other audio/visual aids as may be appropriate,

.2 Instruction during the classroom seminar by the manufacturer's representative regarding the proper operating and maintenance procedures for each item of equipment,

.3 Demonstration of the proper operating procedures for each item of equipment,

.4 Explanation of the purpose and function of all safety devices provided,

.5 Demonstration of all measures required for safe and proper access for operation and maintenance.

3.8.4 Provide a period of follow-up instruction (on two occasions) approximately one (1) month after completing Owner's instruction to clarify and reinforce earlier instructions.

3.8.5 Submit a letter from the Owner's management staff indicating the instruction has been given satisfactorily to the Consultant prior to substantial completion of the project.

3.9 Commissioning

3.9.1 The contractor shall start-up and completely commission all equipment and systems installed under this contract. Commissioning work shall be completed to the satisfaction of the Consultant prior to acceptance of the Work or any part thereof.

3.9.2 The Contractor and his sub-contractors shall each assign an individual representing each of the relevant trades to the commissioning team and shall ensure that representatives of the equipment manufacturers are present during the relevant commissioning tasks.

3.9.3 The Contractor shall provide all necessary labour, materials, equipment, testing apparatus and incidentals necessary to completely start-up, verify, test and commission each system provided as part of the Work.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section describes the verification testing required for the HVAC system.

1.2 Related Sections

1.2.1 Section15010 - Mechanical General Requirements of Section 15010.

1.2.2 Section 15100 - Basic Materials and Methods

1.3 General

1.3.1 All equipment required for the verification of equipment and systems shall be furnished by the agency employed to conduct the Mechanical Systems Verification.

1.3.2 All equipment used by the agency in its verification of mechanical systems remains the property/responsibility of the agency and is not included in the supply to the project.

1.4 Independent Agency

1.4.1 All work of Mechanical Systems Verification shall be undertaken by a single agency, employed under Division 15.

1.4.2 The work of the agency consists of the furnishing of all labour, materials, equipment and accessories necessary in the testing, verification and documentation of the operational performance of all equipment and systems installed under the Sections of Division 15.

1.5 Reference Standards

1.5.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

.1 SMACNA Manual for Balancing and Adjustment of Air Distribution Systems, or

.2 AABC National Standards for Total System Balance, 4th Edition.

.3 Ontario Building Code.

.4 Ontario Fire Code.

1.6 Coordination

1.6.1 Co-operate with installing Contractor(s) in advising them of specific scheduling requirements for systems verification.

1.6.2 Provide advice to installing Contractors regarding the location and installation of devices required to permit system balancing and measurements, prior to start of the installation work.

1.6.3 The Mechanical Contractor shall cooperate with the independent company and perform the functions described below with respect to the balancing and commissioning of the systems.

1.6.4 Consult with the Independent Balancing and Commissioning Company confirming the locations of all volume dampers prior to the installation of ductwork, location of ductwork air volume measuring ports, locations of balancing valves and measuring stations, etc.

1.6.5 Provide the assistance of a qualified mechanic to assist and make all necessary adjustments as directed by the independent company and replace system components (i.e. filters) to achieve the specified system conditions for balancing.

1.6.6 Assist the authorities in all required tests with respect to operation of the systems.

1.7 Measurement and Payment

1.7.1 15020 will be paid for at the price included in the bid form for this section.

1.8 Quality Assurance

1.8.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.

1.8.2 Testing and measuring equipment used in the verification of the mechanical systems shall be calibrated to give true readings within the accuracy specifications of the equipment used. A certificate of calibration from an independent testing laboratory may be required by the Consultant if there is any reason to suspect that the equipment used is giving erroneous readings. In such an event the verification agency shall reconduct its verifications.

1.9 Submittals

1.9.1 Make submittals in accordance with Division 1.

1.9.2 Submit draft copies of Verification Checklists for approval within 30 days of the project start date.

1.9.3 Submit interim reports on a bi-weekly basis detailing the progress of Contractor's balancing and adjusting work and the progress of verification work under this Section including initial findings.

1.9.4 Submit written records of all measurements taken during verification of the equipment and systems, including:

.1 Copies of manufacturer's inspection and start-up reports

1.9.5 Submit a Certificate attesting to the verification of correct and proper operation of all equipment and systems installed under Division 15 in accordance with contract specifications and drawings.

1.10 Operations & Maintenance Manual

1.11 Training

1.11.1 Insert specific training requirements. Make reference to Division 1.

1.12 Site Conditions

1.12.1 Environmental (temperature range, altitude, contaminants, classified areas)

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 Verification Checklist

3.1.1 Prepare a series of checklists to record the verification of each item of equipment and each system. Submit a draft of each checklist to the Consultant and the Owner for review and approval. Discuss comments offered the Consultant and Owner and include improvements as directed.

3.1.2 Checklists shall include the following as a minimum:

.1 Date(s) of observations and/or tests,

.2 Record of the nameplate data for each equipment item and each associated motor,

.3 List of observations appropriate to the equipment item or system with space adjacent to indicate whether the item was satisfactory or unsatisfactory,

.4 Appropriate space for recording comments and/or instructions given during observations.

3.2 Operation and Testing

3.2.1 Test the operation of the individual components and systems. Go through each step of the sequence of operation and verify that each component operates correctly. Direct and ensure that all trades involved make the required changes and adjustments to affect the proper operation of all components and systems. Document the operations and sequences. See Commissioning tests.

3.2.2 In conjunction with the Balancing Contractor document the performance of each component. Verify the operating point of equipment with respect to certified performance data. Review the results with suppliers.

3.2.3 Test records sheets shall be reviewed by the Contract Administrator prior to commencement of testing. The record sheets shall include a list of all specialist personnel, and specialized equipment required for the test to ensure that these are available on the testing date.

3.2.4 Carry out operational tests for the current season and simulate operation of summer, winter and intermediate seasons.

3.3 Documentation

3.3.1 Provide documentation of the commissioning process for inclusion into the maintenance manuals. These are to include check out sheets, report forms, start-up certificates from Suppliers involved in start-up, documentation concerning demonstration to the Owner. Include all record and result sheets from tests specified herein.

3.3.2 Maintain a daily log of key operating parameters, problems encountered, solutions employed and verification of effectiveness of solutions.

3.3.3 Prepare detailed progress reports to coincide with regular commissioning meetings.

3.4 Pressure Tests

3.4.1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments by approved laboratory or manufacturer and furnish certificate showing degree of accuracy. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.

3.4.2 Refrigerant piping: test with nitrogen to 2070 kPa (300psi) on high pressure side and 1030 kPa (150psi) on low side.

3.4.3 Check system during application of test pressure including visual checks for leakage of water test medium, soap bubble test for air or nitrogen test medium and halide torch for refrigerant medium.

3.4.4 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defect. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines. Do not caulk.

3.5 Performance Tests

3.5.1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, adjustments, and replacements requested as tests may indicate prior to operating tests.

3.5.2 Make operating tests for minimum of five (5) days during heating season and cooling season of first year of operation, and at times when directed, for proper settings of controls under peak load conditions.

3.5.3 Conduct final operating tests in presence of the Contract Administrator. Vary loads to illustrate start-up and shut down, sequence, and simulate emergency conditions for safety shut-downs, with automatic and manual reset. Repair and test defects until satisfactory. Make final adjustments to suit exact building conditions.

3.5.4 Provide services of one job mechanic, ladders, tools, and associated equipment required to assist the Contract Administrator in final test.

3.5.5 Calibrate and adjust thermostats, thermometers, gauges, linkage and dampers. Control valves shall operate freely.

3.5.6 Operate and test motors and speed switches for correct wiring and sequences. Check overload heaters in motor starters.

3.5.7 Fasten loose and rattling pieces of equipment. Unit heaters and other equipment shall operate quietly.

3.5.8 Eliminate any noise and vibration if such is not acceptable to the Contract Administrator and Owner at no expense to the Owner.

3.6 Equipment Verification

3.6.1 Test the operation of all equipment installed under Division 15, according to instructions in appropriate articles of this Division. Advise installing contractor of any required adjustments or replacements to ensure that equipment is operating as intended. Retest equipment after adjustment or replacement.

3.6.2 Ensure that the Contractor has given proper advance notification to all persons required to be present as tests are conducted.

3.6.3 Pre-start-up Inspection:

.1 Verify proper equipment mounting and setting.

.2 Verify that control, interlock, and power wiring are complete.

.3 Verify proper piping connections and accessories.

.4 Verify that lubrication is complete.

3.6.4 First Run Observation:

.1 Verify setting of safety controls.

.1 Equipment Checkout:

.1 Verify proper operation of equipment.

.2 Report on inspection, observation, and checkout procedures.

3.6.5 Control Diagrams and Sequences: provide for coordination with work under the automatic control systems to have the control diagrams and sequences of operation corrected to "as installed", reflecting changes brought about in response to contract modifications and to the more pragmatic changes in diagrams and sequences to make the installed system control the building systems as intended by the designer.

3.6.6 Safety and Operating Control Setpoints: systematically verify the safety and operating controls of equipment, including an operational check of associated control sequences.

3.6.7 Verify that manufacturer's start-up procedures have been performed and that equipment is installed in accordance with the manufacturer's written installation recommendations.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Balance and adjust all the new and modified ventilation systems under Division 15 and submit reports.

1.1.2 Balance, adjust and test air systems and equipment and submit reports.

1.1.3 Assist in the commissioning of ventilation systems specified under Division 15.

1.2 Balancing Agenda

1.2.1 General: Prior to commencement of balancing, review with the Engineer methods and instruments to be used in balancing.

1.2.2 Descriptive Data: Review design concepts and general function of each system including associated equipment and operation cycles. Confirm listing of flow and terminal measurements to be performed.

1.2.3 Procedure Data: Outline procedures for taking test measurements to establish compliance with requirements. Specify type of instrument to be used, method of instrument application and correct factors.

1.2.4 Sample Forms: Submit forms showing application of procedures to typical systems.

1.3 Submittals

1.3.1 Submit draft copies of balance reports for approval prior to proceeding.

1.3.2 Revise reports as required and provide for inclusion in Maintenance Manuals.

1.4 System Data

1.4.1 Reports shall include balance and equipment data listed in imperial units.

1.4.2 Report data shall include system description, manufacturer, arrangements, motor size, electrical characteristics, equipment size, design and actual temperature, flows, RPM, power, amperage, pressure (air, static and velocity), air temperature, space temperature and humidity, outdoor temperature and humidity, etc.

1.5 Acceptable Balancing Agencies

1.5.1 Testing and balancing agencies who are approved in principle, but subject to requirements of drawings and specifications are:

.1 Clark Balancing Ltd

.1 Contact: Barry or Steven Clark, (905) 693-1518

.2 Design Test & Balance

.1 Contact: Surrinder Singh, (905) 886-6513

1.6 Alternates

1.6.1 Any alternates shall be pre-approved or must be shown as a savings or reduction on the tender form. Detailed documentation on the alternate units must be included in the tender form complete with contact information for sales representative.

1.7 Commissioning and Documentation

1.7.1 Refer to Section 15044, Commissioning.

1.7.2 Refer to section 01800, Startup and Commissioning.

1.7.3 Refer to section 01780, Closeout Submittals.

1.7.4 Provide all necessary coordination services between the documentation-balancing operations and the commissioning operations.

1.7.5 Work with the commissioning Agent throughout the project to provide necessary tests, adjustments, reports, certifications to complete the project.

2 PRODUCTS

2.1 Maintenance Manual Materials

2.1.1 Provide copies of the final balancing report to the Commissioning Agent.

2.2 Fan Test Reports

2.2.1 Report designed air flow, air pressure at inlet and discharge, air temperature, fan speed, motor current, motor voltage, manufacturer, model, fan wheel size.

2.2.2 Test, adjust and report air flow, air pressure at inlet and discharge, air temperature, fan speed, motor current, motor voltage, manufacturer, model, fan wheel size.

2.2.3 For fans with power greater than 250 watts, plot design and actual pressure and flow on manufacturer's or drafted fan performance curve.

3 EXECUTION

3.1 Site Verification

3.1.1 Provide preliminary review of all new ductwork to verify splitters and balance dampers are in place to allow proper balancing of the system.

3.2 General Procedure

3.2.1 Balance to maximum measured flow deviation from specified values of 10% at terminal device and 5% at equipment.

3.2.2 Mark settings on valves, splitters, dampers and other adjustment devices.

3.2.3 Take measurements to verify balance has not been disrupted or that such disruption has been rectified.

3.2.4 At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Engineer.

3.3 Air System Procedure

3.3.1 Adjust air distribution systems to provide required or design supply and exhaust air quantities.

3.3.2 Make air quantity measurements in ducts by pitot tube traverse of entire cross-sectional area of duct.

3.3.3 Measure air quantities at air inlet and outlet.

3.3.4 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices, such as dampers and splitters.

3.3.5 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

3.3.6 Provide system schematic with required and actual air quantities at each outlet or inlet.

3.3.7 Where modulation dampers are provided, take measurements and balance at all conditions.

3.3.8 Provide new sheaves where necessary.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers the commissioning as specified. In general, the portions of the work are:

.1 Review installation and offer comments or deficiencies.

.2 Commissioning and adjustment of all new systems under Division 15 including controls.

.3 Verification of balancing reports.

.4 Verification and certification of all systems provided or installed under Division 15.

.5 Direction to the Mechanical Contractor for system adjustment and minor changes as required.

.6 Coordination with Division 16 as required.

.7 Participation in equipment training and instructions.

.8 Participation in the hand over of systems to, and the acceptance by the City.

1.2 Submittals

1.1.1 Commissioning Reports: Provide reports for all commissioning steps.

1.1.2 Provide additional reports as required to clearly identify all systems and their operation.

1.1.3 Provide a Deficiency Report for any existing systems being reused and clearly identify all deficiencies for the systems.

1.3 Quality Assurance

1.1.1 Commissioning of mechanical systems shall be performed by an agency that specializes in this type of work.

1.1.2 Technicians performing the work shall be experienced in projects of similar scale and nature.

1.4 System Data

1.4.1 Reports shall include equipment data listed in Metric units.

1.4.2 Report data shall include system description, manufacturer, arrangements, motor size, electrical characteristics, equipment size, design and actual parameters (temperature, flows, RPM, power, amperage, pressure, etc.)

2 PRODUCTS

2.1 Operation and Maintenance Manuals Materials

2.1.1 Review and offer comments on the maintenance manuals as submitted by the Contractor and all its contents.

2.1.2 Prepare proper documentation to assist with instruction to the City in the operation and preventative maintenance of equipment and systems provided. Complete and turn over documentation prior to Substantial Performance inspection.

2.1.3 Refer Division 1.

2.2 Balance Reports

2.2.1 Verify reports specified under section 15043 – Balancing.

2.3 Equipment Test Reports – Commissioning and Start-Up

2.3.1 Provide commissioning reports for all systems and equipment to verify installation and operation.

2.3.2 Review manufacturer's and Contractor's start-up and test reports. Test and adjust equipment and systems as specified, and as required by the manufacturer. Ensure that manufacturers' start-up reports are complete and acceptable.

2.4 Commissioning Services - General

2.4.1 Prior to start of the commissioning process, the Contractor shall submit to the Consultant, the following:

.1 Proposed commissioning schedule and procedures.

.2 Forms and checklists showing the entire list of actual systems and equipment, including all operations and set points that will be checked and reported.

.3 Personnel and equipment that will be used.

2.4.2 Pre-commissioning Meeting: The Commissioning Agent shall organize a meeting with the Consultant, heating Sub-Contractor and Controls Sub-Contractor prior to the start of Phase One Commissioning. The meeting will establish and clarify the requirements and schedule of each member of the construction team, and the method and format of certification and test reports.

2.4.3 Descriptive Data: Review design concepts and general function of each system including associated equipment and operation cycles. Confirm listing of flow and terminal measurements to be performed.

2.4.4 Procedure Data: Outline procedures for taking test measurements to establish compliance with requirements. Specify type of instrument to be used, method of instrument application and correct factors.

3 EXECUTION

3.1 Construction Period Services

3.1.1 The commissioning agent will attend the site during the construction period. The number of site visits shall be as required, and shall be coordinated with the construction process to provide the following:

.1 Comment to the Division 15 Contractors with respect to system configuration and the effect that the construction conditions will have on system performance.

.2 Comment to the Consultant with respect to system configuration and recommendations on field changes that should be considered in order to achieve the system performance specified.

.3 Review all specified design parameters and compare to actual. Instruct Contractor to recommended changes.

.4 Provide written report on recommendations.

3.2 Commissioning Phase One - Pre-Commissioning

3.2.1 Prior to commencing commissioning tasks on any system, confirm or provide the following:

.1 Certification that the subject systems are ready for the commissioning process.

.2 Permanent electrical connections are complete and accepted by the Consultant.

.3 All safety controls are complete and operational.

.4 All operating controls are complete and activated.

.5 Ductwork related to the subject systems are cleaned, and satisfactory filters are installed.

.6 Related vibration isolation components are properly adjusted.

.7 Belt and coupling drive combination specifications and calculations to confirm selection.

3.2.2 Provide written reports on all necessary systems. Do not proceed to the next phase, without written acceptance of this phase, by the Consultant.

3.3 Commissioning Phase Two - Commissioning Operations

3.3.1 As each system is started and tested, and balancing and adjusting is underway or completed, the overall performance of the components and systems, including the controls, shall be tested, properly adjusted, verified under all operating conditions and reported.

3.3.2 Commissioning tasks shall include but not be limited to the following:

.1 In the accompany of equipment suppliers and the Division 15 Contractor, each piece of equipment provided by this Division shall be started and checked for correct operation and for correct interlocking and parallel operation with other equipment and systems.

.2 Activation of all components, systems and sub-systems, both manually and through the automatic control systems.

.3 Testing and adjustment of all components, systems and sub-systems.

.4 Adjustment and securing of all adjustment devices such as dampers, balancing, etc.

.5 Adjustment and calibration of all control and safety devices.

.6 Adjustment and securing of all air inlet or outlet balancing devices.

.7 Adjustment and setting of automatic controls for accurate response and precise sequencing.

.8 Adjustment of vibration isolators.

.9 Receipts from City for:

.1 Spare drive belts - identify each system

.2 Spare Filters

3.3.3 Provide written reports on all necessary systems. Do not proceed to the next phase without written acceptance of this phase by the Consultant.

3.4 Commissioning Phase Three - Verification of Commissioning

3.4.1 Verification of commissioning by the Consultant shall not commence until Phase Two Commissioning is totally complete.

3.4.2 Operate and demonstrate entire system operation with the Consultant present. The Consultant will indicate acceptance of the tests by initialling items on the checklists. The commissioning process will not be considered complete until all system components are tested and accepted in concert with all other systems.

3.4.3 Submit test reports, test completion certificates, and related data at the time of requesting the commencement of the verification phase.

3.4.4 The verification process will include, but not be limited to the following:

.1 Locating and demonstrating the opening capability of all access panels, and confirming that the record drawings show these devices in the correct location.

.2 Locating and demonstrating the accessibility and setting of all air flow balancing dampers, and confirming that the record drawings show these devices in the correct location.

.3 Locating and demonstrating proper operation of fire dampers, randomly selected by the Consultant, and confirming that the record drawings show these devices in the correct location.

.4 Demonstrate noise levels from air handling systems in all modes of operation.

.5 Verifying operation of all systems and components in all sequences, and under varying loads. The commissioning agent will require thorough knowledge of the control system in order to adjust and reset operating ranges in order to force the systems into required demonstration modes.

.6 Verifying all mechanical systems control features.

.7 Demonstration of inlet and outlet temperature readings on heat transfer elements, randomly selected by the Consultant. The commissioning agent must have performance specifications available during the demonstration, for comparison of the temperature readings.

3.4.5 Provide written reports on all necessary systems. Do not proceed to the next phase, without written acceptance of this phase, by the Consultant.

3.5 Commissioning Phase Four – Demonstration, Training, Hand Over & Acceptance

3.5.1 Demonstration to the City's designated representatives shall not commence until Phase Three services are totally completed.

3.5.2 Substantial Performance will not be considered until the successful completion of Phase Four Commissioning.

3.5.3 The process of Demonstration, Training, Hand Over and Acceptance is a planned process, requiring pre-approval of the plan and stages, and a signed statement of Acceptance by the City's designated representative at the completion of each stage of the process.

3.5.4 As the project moves close to the final stages, a formal dialogue will be established by the Consultant, the City and the Contractor, in order to schedule times, dates and required personal for systems and equipment commissioning, demonstration and training. Allow for a minimum of four (4) separate four (4) hour sessions.

3.5.5 The City will attend on the site on a scheduled basis, to inspect and review the installation. The Contractor shall arrange for all necessary and specified personnel and equipment specialists to be in attendance for purposes of demonstrating and training.

3.5.6 If systems are deemed complete and acceptable by the Consultant and the City, the City will signify acceptance by signing a formal hand over receipt relating to the subject system or equipment. If systems are not deemed complete and acceptable by the Consultant and the City, the Contractor will re-schedule the session for a future time. The costs of the Consultant's and City's attendance at this or other subsequent sessions will be charged to the Contractor.

3.5.7 The Consultant will issue lists of required submissions, receipts and acceptance forms, for execution by the Contractor.

3.5.8 The services to be provided in this phase include, but are not limited to the following:

.1 Participation in training of all systems provided under this Division.

.2 Participation in training of the control system.

.3 Work with the Contractor to provide a documented maintenance program covering all systems provided or modified under this contract.

.4 Review of all documents and reports created during Phases One, Two, and Three of the commissioning process.

.5 Final certification letters from the commissioning agent, balancing Contractor, controls Contractors, and the Division 15 Contractor(S), that all systems are installed and operating, providing the intended service to the building.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install the following:

.1 Equipment supports.

.2 Flashing for mechanical equipment.

.3 Sleeving for mechanical equipment.

1.1.2 Provide Shop drawings and structural design calculations signed and stamped by a Professional

1.1.3 Engineer, licenced in the Province of Ontario, confirm the support system can resist seismic and

1.1.4 wind forces against uplift and sliding.

1.1.5 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade

1.1.6 and provide for expansion and contraction.

1.1.7 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate

1.1.8 adjacent to equipment to prevent undue stresses in piping and equipment.

1.1.9 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.

1.2 Submittals

1.2.1 Firestop materials: Submit service limitations, installation instructions, ULc certification and FM listing.

1.2.2 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, ULc certification and FM listing.

1.3 Alternatives

1.3.1 Obtain approval prior to drilling for inserts and supports for piping systems.

1.3.2 Obtain approval prior to using percussion type fastenings.

1.3.3 Use of perforated band iron, wire or chain as hangers is not permitted.

2 PRODUCTS

2.1 General

2.1.1 All rods and anchors shall be stainless steel.

2.1.2 All hangers and other supports shall be galvanized steel or stainless steel.

2.2 Flashing

2.2.1 Steel Flashing: 26 gauge galvanized steel.

2.2.2 Lead Flashing: 24.5 (5 lb/ft2) sheet lead.

2.2.3 Aluminum flashing: 26 gauge sheet aluminum.

2.3 Sleeves

2.3.1 Pipes through wall: Form with steel pipe, schedule 20, galvanized.

3 EXECUTION

3.1 Low Pressure Duct (LPD) Hangers and Supports

3.1.1 Hanger minimum sizes:

.1 Up to 750mm (30“) wide or 330mm (13“) diameter: 1¼” x 16 gauge at 3m (10ft) spacing.

.2 750mm (30“) to 1200mm (48“) wide, or over 450mm (18“) diameter: 1½“ x 16 gauge at 3m (10ft) spacing.

.3 Over 1200mm (48“) wide: 1½” x 16 gauge at 3m (10ft) spacing.

3.1.2 Horizontal duct on wall supports minimum sizes:

.1 Up to 450mm (18“) wide: 1½” x 16 gauge or 1“ x 1“ x 1/8“ at 3m (10ft) spacing.

.2 450mm (18“) to 1000mm (40“) wide: 1½” x 1½” x 2“ at 1.8m (6ft) spacing.

3.1.3 Vertical duct on wall supports minimum sizes:

.1 Riveted or screwed to duct:

.2 Up to 1500mm (60“) wide: 1½” x 1½” x 3 “

.3 Over 1500mm (60”) wide: 2 “ x 1/8 “

3.2 Equipment Supports

3.2.1 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

3.2.2 Provide rigid anchors for ducts immediately after vibration connections to equipment.

3.2.3 Suspend mechanical equipment from structure with adjustable length steel rods. Provide spreader beams to distribute weight.

3.3 Flashing

3.3.1 Where mechanical equipment passes through weather or waterproofed walls, counter flashing shall be provided under this Division.

3.4 Sleeves

3.4.1 Provide and set sleeves required for equipment, including openings required for placing equipment.

3.4.2 Set sleeves in position in advance of other work. Provide suitable reinforcing around sleeves.

3.4.3 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

3.5 Labelling and Painting

3.5.1 Painting of all ductwork and hangers is by Division 9.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 The requirements of this section apply to and form part of all sections of Division 15 - Mechanical

1.2 Related Sections

1.2.1 Division 1 - General Requirements All Sections

1.2.2 Division 3 - Concrete All Sections

1.2.3 Section 05500 - Metal Fabrications

1.2.4 Section 09900 - Painting

1.2.5 Division 13 - Instrumentation, Control and SCADA All Sections

1.2.6 Division 15 - Mechanical All Sections

1.2.7 Division 16 - Electrical All Sections

2 PRODUCTS

2.1 Sleeves, Plates and Escutcheons

2.1.1 Where pipes pass through walls provide schedule 40 steel pipe sleeves. Provide sleeves through walls and floors for insulated piping of sufficient size to allow insulation to pass through unbroken, with 15 mm clearance all around; otherwise allow for 25 mm clearance all around. Terminate sleeves flush with walls and 25 mm above floors.

2.1.2 Provide split type floor and ceiling plates Grinnell Figures 1 and 2 for copper tubes or Grinnell Figures 10, 13 and 20 for steel pipe. For unfinished floors use Figure 400 special concrete floor plates. Where exposed pipe passes through finished floors, walls or ceilings, provide chrome plated with setscrew. Terminate pipe sleeves at these locations, so that sleeve ends are covered by plates. Secure plates against finished surface. For pipe sleeves through basements and mechanical room floors provide watertight riser sleeve Figure 405 complete with gasket.

2.1.3 Use factory made, threaded or toggle type inserts for supports and anchors, sized for load to be carried. Place inserts only in portions of main structure and not in any finishing material.

2.1.4 Use factory made expansion shields where inserts cannot be placed but only where approved by the Engineer and only for light weights. Make holes for inserts using drill, no ram setting permitted.

2.2 Unions, Flanges and Dielectric Couplings

2.2.1 Provide unions or flanges at connections to equipment or fixtures requiring servicing or replacing, installed to permit equipment servicing or removal without disturbing piping.

2.2.2 For copper pipes use wrought copper unions with soldered joints up to and including 50 mm (2”). Use brass ground joints for 65 mm (2-1/2”) and 75 mm (3”) pipe. Use 1050 kPa (152psi) cast brass flanges for pipes 10 mm (13/32”) and larger.

2.2.3 Use carbon steel machine bolts with one nut for flanged connections, ASTM A307 Grade B.

2.2.4 Install approved dielectric coupling insulation at transition between materials such as copper, brass, bronze, high alloy castings or stainless steel and low alloy ferrous materials such as black iron, steel galvanized iron, or cast iron. Install dielectric insulators so that they are not shorted out by accidental contacts to process equipment, building steel, instrumentation tubing or electrical neutrals. Provide dielectric unions constructed of materials that are compatible galvanically with the systems to which they are connected, i.e. a dielectric union for installation between copper and iron shall be constructed with a body of iron and a tailpiece of copper or brass.

2.2.5 For insulating flanged connections use flange insulation kit designed for use in standard flanges with standard blots. Align flanges so that sleeves can be inserted easily by hand. Avoid nut over-tightening, a torque wrench is recommended. After assembly, each bolt should withstand a 500 V megger insulation test between each bolt and each flange.

2.2.6 For threaded joints use insulated union with a steel body and a brass tailpiece.

2.2.7 Use similar types of dielectric insulation to electrically isolate piping systems that are cathode protected.

2.3 Hangers and Supports

2.3.1 Provide Shop drawings and structural design calculations signed and stamped by a Professional Engineer, licenced in the Province of Ontario, confirm the support system can resist seismic and wind forces against uplift and sliding.

2.3.2 Provide engineered support systems as required to suit the respective HVAC equipment and ducting systems.

2.3.3 Provide all frames and supports for the proper erection of the work. Fabricate from structural steel any supporting sections and frames required.

2.3.4 All support hangers to be of corrosion resistant material including:

.1 316 Stainless Steel

.2 Aluminium

.3 PVC encapsulated metal

2.3.5 Provide pipe hangers with supports, for piping in Division 15 with rods vertical, without bends or offsets such that finished piping is true, both with respect to line and grade.

2.3.6 Support hangers directly from structure. Do not support pipes or other equipment from other pipes, ducts, equipment, suspended ceilings or metal roof decks, etc.

2.3.7 Suspend hanger rods from inserts in concrete or from beam clamps. Obtain the Engineer's approval prior to welding to steel structural members. Ensure that load imposed on structure does not exceed structural design load. Suspend from top chords of steel joists or top or bottom flange of steel beams using beam clamps.

2.3.8 For support of horizontal piping use round steel threaded rod having the following diameters and spaced at the following intervals:

STEEL PIPE					
PIPE DIAMETER (mm)		**HORIZONTAL SPACING OF SUPPORTS (mm)**		**THREADED ROD DIAMETER (mm)**	
mm	inch	mm	ft	mm	inch
13	1/2	1500	5	10	3/8
20	3/4	1800	6	10	3/8
25	1	2100	7	10	3/8
32	1-1/4	2400	8	10	3/8
40	1-1/2	2700	9	10	3/8
50	2	3000	10	10	3/8

COPPER TUBING, ANNEALED STEEL TUBING AND PVC PIPING AT MAXIMUM 40Ec					
PIPE DIAMETER (mm)		**HORIZONTAL SPACING OF SUPPORTS (mm)**		**THREADED ROAD DIAMETER (mm)**	
mm	inch	mm	ft	mm	inch
13	1/2	1500	5	10	3/8
20	3/4	1500	5	10	3/8
25	1	1800	6	10	3/8
32	1-1/4	2100	7	10	3/8
40	1-1/2	2400	8	10	3/8
50	2	2400	8	10	3/8

2.3.9 Do not use pipe hooks, chains, or perforated straps.

2.3.10 Use angle or channel iron welded frames for trapeze hangers.

2.3.11 Hangers for uninsulated pipes to be Grinnel Fig. 65 adjustable wrought iron clevis up to including 100 mm and Grinnel fig. 260 adjustable wrought iron clevis for sizes 125 mm (5”) and larger, or approved equal.

2.3.12 Hangers for insulated pipes with hanger around insulation to be provided with insulation shield, minimum 300 mm (12”) long, 18 gauge, galvanized sheet metal between insulation covering and hanger. Tack weld shield to hanger.

2.3.13 For hangers on copper pipe use copper plated or steel with insulating bushing. Copper pipes must not contact steel pipe or hangers.

2.3.14 Support vertical pipes with riser clamps or ring stays. Spacing of vertical pipe supports to conform with spacing of horizontal supports.

2.3.15 Where pipes change direction either horizontally or vertically provide pipe hanger not more than 300 mm (12”) from elbows. Where pipes drop from branches of tees support main run in both directions not more than 900 mm (36”) on each side of tee. Where changes in direction are used for expansion, use linked eye hanger rods.

2.3.16 Erect structural work required for support of mechanical equipment. Include angle frames, anchor bolts, guy wires, platforms, braces, etc. required to support equipment, ductwork, piping, etc. Supports to have ample strength to carry equipment under testing and operating conditions. In addition, supports must meet normal acceptable engineering practices and be approved by the Engineer.

2.3.17 Set equipment baseplates on minimum 13 mm (1/2”) thick concrete grout.

2.3.18 Incorporate all requirements of vibration mountings manufacturer, where vibration mountings are required between equipment and base, or inertia base and at hangers.

2.3.19 Support and Attachment: support and attach piping, ductwork fixtures and equipment from load bearing structures such as beams, joists, reinforced concrete slabs and concrete block walls, and do not support from or attach to steel roof deck and/or wall or ceiling finishes.

2.4 Identification of Equipment

2.4.1 Manufacturer's Nameplates:

.1 Provide metal nameplates on each piece of equipment, mechanically fastened with raised or recessed letters.

.2 Include registration plates, Underwriters' Laboratories and CSA approval, as required by respective agency and as specified. Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors, all factory supplied.

.3 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

2.4.2 System Nameplates:

.1 Provide laminated plastic plates with black face and white centre of minimum size 90mm x 40mm x 2 mm (3-1/2" x 1-1/2" x 3/32") nominal thickness, engraved with 6mm (1/4") high lettering. Use 25mm (1") lettering for major equipment.

.2 Fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.

.3 Identify equipment type and number and service of areas or zone of building served. Use existing coding system for building additions and alterations

.4 For each item of equipment which may be started automatically or remotely, add a red lamacoid plate, 60mm x 230 mm (2-1/2" x 9"), reading:

"WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED. IT MAY START AT ANY TIME."

2.4.3 Identification of Piping

.1 Identify service in piping with markers showing name and service including temperature, if multi-temperature systems are used and directional flow arrows. Apply markers on clean and dry finished insulation or piping surfaces. Use existing coding system for building additions and alterations.

.2 Identify medium in piping with markings showing name and service including temperature, pressure and directional flow arrows in accordance with CGSB 24 GP-3a.

.3 On all piping apply manufactured pipe markers of plastic-coated cloth material with protective over-coating and waterproof contact adhesive under-coating, suitable for continuous operating temperature of 82°C (180°F). Apply to prepared surfaces. Use block capital letters 50 mm (2”) high.

.4 Locate Pipe Identification as follows:

.1 Locate markings and classifying colour on piping systems so they can be seen from floor or platform.

.2 Identify piping runs at least once in each room.

.3 Do not exceed 15 metres (50 ft.) between identifications in open areas.

.4 Identify both sides where piping passes through walls.

.5 Identify piping at starting and ending points of runs and at each piece of equipment.

.6 Identify piping at major manual and automatic valves immediately upstream of valves. Where this is not possible, place identification as close to valve as possible.

.7 Identify branch, equipment or building served after such valve.

.5 Identification labels may be stenciled. Identification arrows labels and letters may be vinyl cloth (Brady B500) or vinyl film (Brady B946), with adhesive compatible with the surface temperature.

.6 Identification colour bands for primary and secondary colours to indicate the type and degree of hazard shall be applied to overlap a minimum of 50mm (2"). Bands shall be Brady B550 vinyl cloth tape or Brady B946 vinyl tape, with adhesive compatible with the surface temperature.

2.4.4 Identification of Valves and Controllers

.1 Use existing coding system for new building, additions and alterations on site.

.2 Provide aluminum or brass tags with 13 mm (2") stamped code lettering and numbers filled with black paint, secured with non-ferrous chains or `S' hooks for all valves and operating controllers.

.3 Provide Consultant with six identification flow diagrams of approved size for each system. Include tag schedule, designating number, service, function, and location of each tagged item and normal operating position of valves.

.4 Install where directed one copy of flow diagram and valve schedule mounted in glazed frame. Provide one copy in each Operation and Maintenance Manual.

.5 Consecutively number valves in systems.

2.5 Hoisting and Scaffolding

2.5.1 Perform all unloading, hoisting and warehousing for all mechanical equipment and materials and assume responsibility for damage caused to the property of the Region in the performance of the work.

2.5.2 Ensure that all equipment can be hoisted and set into the specified location. Include for the cost of dismantling and reassembling of equipment where required. Reassembly shall be to the equipment manufacturer's written approval.

2.6 Electric Motors

2.6.1 Unless specified otherwise, use motors with following characteristics:

.1 Smaller than 372W (1/2 HP) - 120 volt, 60 hertz, single phase

.2 372W (1/2 HP) and over - refer to Mechanical-Electrical Schedule

2.6.2 Motors smaller than 372 W (1/2 HP): Provide continuously rated squirrel cage induction type with capacitor start, EEMAC `N' starting characteristics and a minimum of Class `A' insulation.

2.6.3 Motors 372 W (1/2 HP) and over: Provide continuously rated squirrel cage induction type with EEMAC `B' starting characteristics and a minimum of Class `B' insulation.

2.6.4 Provide constant speed motors with reduced voltage starters where specified.

2.6.5 Unless specified otherwise, starters for electrical motors will be provided by Division 16.

2.6.6 Motor ratings rated in watts refer to output watts.

2.6.7 Coordinate with Division 16 the sizing of electrical protective devices supplying new and relocated mechanical equipment that contain integral motor starters and contactors.

3 EXECUTION

3.1 General Installation Requirements

3.1.1 Determine location and size of all mechanical items to be placed in work of other trades. Properly place or supply to other trades items for placement in ample time so that work of other trades is not held up. Absorb any cost involved due to late arrival of items. Prepare sleeving drawing for submission to the Engineer indicating all wall, floor and roof penetrations for ducts and piping with dimensions. Coordinate information on sleeving drawing with structural steel and architectural drawings.

3.1.2 Provide supports, and hangers for all mechanical HVAC infrastructures including but not limited to split systems and piping.

3.2 Cutting and Patching

3.2.1 Supply labour, materials, tools and equipment to complete work of cutting and patching. Include cutting and patching of all mechanical openings regardless of size; and responsibility for damages caused to building components during the performance of mechanical cutting and patching work. Cutting and patching of any building component shall be performed by tradesman skilled in the particular work involved (i.e. masons, drywallers etc.).

3.2.2 Cut, patch and make good so as to leave work in a finished condition. Fill any holes left in floors and walls.

3.2.3 Cutting of any building structural element must have the Engineer's approval.

3.3 Painting

3.3.1 Deliver equipment to site painted with one (1) heavy coat of rust resisting primer or prefinished with standard factory applied baked enamel finish unless otherwise specified. All final painting inside and outside building is by Section 09900 - Painting.

3.3.2 Repair minor damage to finish of equipment with standard factory applied baked enamel finish under the appropriate Sections of this division. Replace entirely, items suffering major damage to finish if too extensive to be repaired in the opinion of the Consultant.

3.3.3 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.

3.3.4 Touch up any damage to prime coat. Protect equipment and prefinished panels throughout construction period.

3.4 Cleaning and Protection

3.4.1 Protect all buildings and structures from damage due to carrying out any work.

3.4.2 Protect finished and unfinished mechanical work from damage. Maintain services and equipment dry and clean.

3.4.3 Cover all openings in equipment and material.

3.4.4 Prior to Substantial Completion, clean equipment in accordance with Division 1.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide all required gauges and thermometers.

1.2 References

1.2.1 CGSB 14.4 Thermometers, Liquid in Glass, Self-Indicating, Commercial/Industrial Type
1.2.2 CGSB 14.5 Thermometers, Bimetalic, Self-Indicating, Commercial/Industrial Type
1.2.3 ASME B40.100 Pressure Gauges and Gauge Attachments

1.3 Submittals

1.5.1 Submit shop drawings of gauges and thermometers.

2 PRODUCTS

2.1 Flow Fittings

3.1.1 Cast brass threaded on sizes 15 mm through 50 mm. Sizes 65 mm and over shall be cadmium plated cast steel with welding ends.

3.1.2 Accuracy shall be plus or minus 1% and permanent pressure loss shall not exceed 25% of the pressure differential reading.

3.1.3 Each flow fitting shall be complete with an identification tag, conversion chart, quick disconnect gauge fittings and shut off cocks.

3.1.4 One differential meter shall be complete with hoses, shut-off fittings, bleed valves and carrying case.

3.1.5 Bell and Gossett Circuit Sensor, Type A.

3.2 Flow Meters

3.3.1 All flow meters shall be manufactured by Annubar. Model No. 1151DP consisting flow sensor, transducer, gauges, mounting flange and all accessories.

3.3.2 Accuracy shall be plus or minus 0.2% of calibrated span and +/-1% zero error per 55^0C. Permanent pressure loss shall not exceed 25% of the pressure differential reading. Accuracy shall be constant to turndown ratio 25 to 1. Flow fitting shall be diamond shape.

3.3.3 Each flow fitting shall be complete with an identification tag, conversion chart, quick disconnect gauge fittings and shut-off cocks.

3.3.4 One differential meter shall be complete with hoses, shut-off fittings, bleed valves and carrying case

3.3.5 Flow meters shall be selected for the temperature and pressure of installation. Transducer shall be selected for maximum pressure drop range.

3.4 Pressure Gauges

3.5.1 Gauges shall be 110mm diameter 1% accuracy cast aluminum case, aluminum ring, phosphor bronze bourdon tube, brass movement, front recalibrator and glass window.

3.5.2 Dials shall read metric units (kPa).

3.5.3 For gauges on liquid service provide a bronze pulsation damper and needle valve.

3.6 Pressure Gauge Taps

3.7.1 Provide 6 mm NPT needle valve.

3.8 Thermometers - Liquid Systems

3.9.1 Thermometers shall be 225mm scale adjustable angle, cast aluminum case, red reading mercury, glass front and complete with 20mm NPT brass separable well, Celsius scale.

3.10 Meter and Gauge Ranges

3.11.1 Meter and gauge range shall be selected to read at midscale of normal operating conditions.

4 EXECUTION

4.1 Installation

5.1.1 Provide one differential meter for venturi fittings. Provide meter for each range.

5.1.2 Enlarge pipes smaller than 65mm for installation of thermometer wells.

5.1.3 Install gauges in locations and angles that are easily readable from normal sight:

.1 Pressure Gauges :

.1 Both sides of Backflow Preventer.

.2 Stem Type Thermometers:

.1 Hot water tank outlet.

5.2 Meter and Gauges Schedule (Also Refer to the Drawings)

5.3.1 Locate meters and gauges in the following locations and as shown on the drawings.

.1 Positive Displacement Meter

.1 Potable Water (Domestic Cold Water)

.2 Pressure Gauges

.1 Expansion Tanks

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install refrigerant piping serving split heat pump system.

1.2 Related Sections

1.2.1 Section 15010 - Mechanical General Requirements

1.2.2 Section 15100 - Basic Materials and Methods

1.3 Submittals

1.3.1 Submit in accordance with Division 1.

1.3.2 Submit in accordance with Section 15010 - Mechanical General Requirements

1.4 Shop Drawings

1.4.1 Submit shop drawings and product data sheets as follows:

.1 Product Data: Provide for all products specified in this section.

.2 Refrigerant Piping Schematics: Submit a schematic piping diagram for each piping system, each diagram indicating pipe sizes, slopes equipment traps, valves and accessories.

.3 Certification Reports: Submit letters from refrigeration equipment suppliers certifying proper stat-up installation as specified in Part 3 of this specification.

2 PRODUCTS

2.1 Refrigerant Pipe, Fittings and Joints

2.1.1 Type "L" hard drawn seamless copper tubing (ACR) to ASTM B88, factory cleaned in accordance with ASTM B280 and ANSI B9.1-1971, pressurised or pre-purged with nitrogen and supplied with capped ends, and complete with factory washed and capped wrought copper soldering fittings, and solder joints made with high melting point silver brazing alloy conforming to AWS Classification BCuP-5.

2.2 Refrigerant Piping Valves and Accessories

2.2.1 Meuller Brass Co. "Streamline" valves and accessories as follows:

.1 Ball Type Shut-off Valves: "Ballmaster", 1/4 turn, CSA certified forged brass ball valves, each suitable for a maximum working pressure of 3445 kPa (485 psi), and complete with carbon filled teflon ball seals, two O-ring stem seals, a gasketed seal cap, a flow direction arrow cast into the body, a ball position indicator on the stem, and extended copper tube solder connections to permit soldering the valve into the line without disassembling the valve

.2 Diaphragm Type Shut-Off Valves: "Linemaster" forged brass, frost-proof, Type 1 Series, CSA certified packless diaphragm type line valves, each suitable for a maximum working pressure of 3445 kPa (485 psi), and each complete with an O-ring to prevent moisture from entering the diaphragm chamber, one phosphor bronze and two stainless steel diaphragms, and extended copper tube solder connections.

.3 Check Valves: "Checkmaster" check valves, straight through type for valves 6.4 mm to 16 mm (1/4” to 5/8”), globe type for valves 22 mm (7/8”) and larger, as follows:

.1 Straight through type check valves are to be complete with a machined brass gasketed body, phosphor-bronze spring, neoprene seat, and extended copper tube solder connections.

.2 Globe type check valves are to be complete with a cast bronze body, forged brass cap, phosphor-bronze spring, teflon seat disc, and neoprene O-ring seal.

.4 Piping Traps: Style No. WE-554P solder end type copper "P" traps

.5 Pressure Vessel Relief Valves: "Safetymaster", factory set (relief pressure) refrigerant vessel pressure relief valves, straight-through or angle type as required, each constructed in accordance with requirements of ANSI Code B9.1 and the ASME Code for Unfired Pressure Vessels, and each complete with a brass body, neoprene seat disc, and lead seal and locking wire

.6 Refrigerant Liquid-Moisture Indicators: "Vuemaster", forged brass, triple sealed, CSA certified liquid-moisture indictors, each suitable for a maximum working pressure of 3445 kPa (485 psi), and complete with a liquid indicator which shows "FULL" when the system is fully charged with refrigerant and remains blank when there is a restriction or shortage of refrigerant in the liquid line, a moisture indicator which changes from blue to pink when moisture is present in the system, a plastic dust cover, and extended copper tube solder connections

.7 Liquid Line Filter-Drier: "Drymaster Micro-Guard" CSA certified filter-driers, each suitable for a maximum working pressure of 3445 kPa (485 psi), and complete with a combination of desiccants in a fluted briquette for drying, and a fluted briquette type filter

2.2.2 All refrigerant piping valves and accessories are to be factory cleaned, washed and supplied with capped ends.

2.3 Refrigerant Piping Flexible Connections

2.3.1 Flexonics "VIBRA-SORBERS" or approved equivalent phosphor bronze construction, factory cleaned, dried and sealed flexible pipe connections with soldering ends.

3 EXECUTION

3.1 Installation

3.1.1 Provide all required refrigerant piping. Pipe is to be type "L" hard copper, factory cleaned, capped, and marked "ACR".

3.1.2 Refrigerant piping and direct expansion refrigeration equipment must be installed by skilled and qualified refrigeration mechanics.

3.1.3 The exact arrangement and installation of refrigerant piping is to be reviewed with and approved by the direct expansion refrigeration equipment manufacturer both prior to and after installation of the piping and equipment.

3.1.4 Make all refrigerant pipe solder joints using a light coat of an approved brazing flux applied to both pipe and fittings. Do not use an acid flux. During the soldering process, ensure that the pipe and fittings are kept full of nitrogen or carbon dioxide to prevent scale formation.

3.1.5 Provide shut-off valves to isolate each piece of equipment if shut-off valves are not supplied integral with the equipment. Shut-off valves inside the building are to be ball or diaphragm type. Shut-off valves outside the building are to be diaphragm type.

3.1.6 Provide a refrigerant charging valve for each system if such a valve is not supplied integral with equipment.

3.1.7 Provide all refrigerant piping system accessories shown. Install in accordance with the manufacturer's instructions. Provide all required refrigerants.

3.1.8 Provide flexible connections at piping connections to the roof mounted condensing unit. Install in accordance with the manufacturer's instructions.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install piping insulation.

1.2 Related Sections

1.2.1 Section 15010 - Mechanical General Requirements.

1.2.2 Section 15100 - Basic Materials and Methods.

1.2.3 Division 9.

1.3 Reference Standards

1.3.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.9, Mineral Fibre Thermal Insulation for Piping and Round Ducting

.2 CAN/CGSB-51.12, Cement, Thermal Insulation and Finishing

.3 CGSB 51-GP-52Ma Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

.4 CGSB 51-GP-53M, Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels and Round Ducts

1.3.2 American Society for Testing and materials (ASTM)

.1 ASTM C 195 Specification for Mineral Fiber Thermal Insulating Cement

.2 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic Setting Thermal Insulating and Finishing Cement

.3 ASTM C 534, Specification for Mineral Fiber Preformed Pipe Insulation

.4 ASTM C553, Specification for Mineral Fiber Blanket and Thermal Insulation for Commercial and Industrial Applications

.5 ASTM C 921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

.6 ASTM E 84, Test Methods for Surface Burning Characteristics of Building Materials

.7 ASTM E 96, Test Methods for Water Vapor Transmission of Materials

.8 ASTM C411-82

1.3.3 Underwriter's Laboratories Of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies

1.3.4 Thermal Insulation Association of Canada (TIAC)

.1 TIAC National Insulation Standards, Section 4 Insulation Materials and Properties

.2 TIAC National Insulation Standards, Section 5 Commercial Piping

.3 TIAC National Insulation Standards, Section 13 Installation Details

.4 TIAC National Insulation Standards, Section 14 Glossary and Definitions

1.3.5 Measures for Energy Conservation in New Buildings, Associate Committee of the National Building Code (ACNBC).

1.3.6 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1

1.3.7 National Fire Protection Association (NFPA)

.1 NFPA 255

1.4 Submittals

1.4.1 Submit in accordance with Division 1.

1.4.2 Submit in accordance with Section 15010 - Mechanical General Requirements

1.5 Shop Drawings

1.5.1 Submit shop drawings for the following equipment items:

.1 Rigid Pipe Insulation

.2 Refrigerant Pipe Insulation

1.6 Definitions

1.6.1 "Concealed" means insulated mechanical services and equipment in trenches, chases, furred spaces, pipe shafts or above suspended ceilings. Services in tunnels will not be considered to be concealed.

1.6.2 "Exposed" will mean "not concealed" as defined herein. The following areas are designated as "exposed" where the term is applied to covering:

.1 Mechanical equipment rooms.

.2 Below suspended ceiling level in occupied areas.

.3 In any occupied area where no ceiling is present or where services and equipment are visible.

.4 Anywhere else indicated on the drawings or in the specifications.

2 PRODUCTS

2.1 Rigid Pipe Insulation

2.1.1 Material: moulded glass fibre or mineral wool insulation, longitudinally split, and complete with 1-1/2" (38 mm) jointing lap having pressure sensitive adhesive applied to inside surface. Insulation to have a thermal conductivity (k-factor) at the mean rating temperature as follows:

Operating Temperature Range	Conductivity Range	Mean Rating Temperature
F (C)	**Btu.in/(h.ft.2 F) (W/(m. K))**	**F (C)**
>350 (176)	0.32-0.34 (0.046-0.049)	250 (121)
251-350 (122-176)	0.29-0.31 (0.042-0.045)	200 (93)
201-250 (94-121)	0.27-0.30 (0.039-0.043)	150 (66)
141-200 (61 - 93)	0.25-0.29 (0.036-0.042)	125 (52)
105-140 (41-60)	0.24-0.28 (0.035 -0.040)	100 (38)
40-55 (4.4-12.8)	0.23-0.27 (0.034-0.039)	75 (24)
<40 (4.4)	0.23-0.27 (0.034-0.039)	75 (24)

Refer to ASHRAE Std. 90.1 for thermal conductivities outside ranges indicated

2.1.2 Acceptable Products: Fiberglas Canada Inc. Standard Temp Pipe Insulation with ASJ; Manson Insulation Inc. Alley-K with APT/ Knauf Fibreglass; Manville Micro-Lok with AP-T Plus; Roxul-Seitz.

2.1.3 AKoolphen K@ phenolic foam insulation with a thermal conductivity of 0.13 BTU.in/Hr.Ft2. F and factory applied ASJ jacket is acceptable. Thickness of insulation shall provide equivalent or better thermal resistance (R-factor).

2.2 Refrigerant Pipe Insulation

2.2.1 Material: closed cell foamed plastic tubular pipe insulation, density of 5.4 lb./ft3 (86 kg/m3). Insulation shall have maximum average thermal conductivity (k factor) of 0.253 BTU.in/hr.ft. F (0.036 W/m/ C) per hour at a mean temperature of 75 F (24 C) and suitable for operating temperatures from -40 F to 220 F (-40 C to +104 C).

2.2.2 Acceptable Products: Armstrong Armaflex.

2.2.3 PVC Fitting covers: to CSGB 51-GP-53M.

.1 One piece premolded PVC insulated fitting covers to be 0.015 in [0.38 mm] minimum thickness, which shall be made to fit over a variety of fittings. Suitable for a maximum average thermal conductivity of as indicated in table in part 2.1.a of this section.

.2 Required Ratings: Flame Spread: 25 or less Smoke Developed: 50 or less

.3 Acceptable product: Johns Manvile Zeston; Fiberglas Canada Inc., Knauf Fibre Glass; Manson.

2.3 Fastenings

2.3.1 Tape

.1 Foil Scrim Kraft (FSK) with self adhesive, 4" (100 mm) wide rated under 25 for flame spread and under 50 for smoke development.

.2 Acceptable product: Mactac.

2.3.2 Contact Adhesive

.1 Quick-setting, non-flammable fire resistive adhesive to adhere fibrous glass to ducts. Flame spread 15 smoke development 0.

.2 Acceptable Product: Foster 85-20 Spark-Fas, Armstrong 520.

2.3.3 Lap Seal Adhesive

.1 Quick-setting adhesive for joints and lap sealing of vapour barriers. Flame spread 10 smoke development 0.

.2 Acceptable Product: Foster 85-75 Drion.

3 EXECUTION

3.1 Installation / Application

3.1.1 Install mechanical insulation in accordance with TIAC National Insulation Standards.

3.1.2 Apply all insulation, wrapping, vapour barrier, jacket, adhesives, coatings and cement in strict accordance with manufacturer's installation instructions.

3.1.3 Work shall be performed by insulation journeymen. All work covered under this Section shall be performed in a workmanlike manner, finished to present a neat appearance.

3.1.4 Do not apply insulation and finishing when the ambient temperature is below 10_C in the space.

3.1.5 Use insulation materials on cold piping which are non-hygroscopic and which are complete with a continuous fire-resistant vapour barrier. Maintain uninterrupted continuity and integrity of vapour barrier.

3.1.6 Do not use wheatpaste or any other material that is prone to formation of moulds.

3.1.7 Do not use staples on vapour barriers.

3.1.8 Apply insulation in a manner facilitating the replacement of and/or servicing of equipment. Terminate insulation neatly around openings and items that require periodic access. Insulate separately with removable 1.7 mm galvanized sheet steel boxes lined with rigid slab insulating material providing equivalent insulation to that on the adjoining surface.

3.1.9 Provide blank ends of covering with 0.7 mm metal caps over insulation but under finish.

3.1.10 Make good any existing insulation and covering damaged during the work of this Contract, using materials of equal quality as existing.

3.1.11 Make good and refinish cracks, undulations or any other deficiencies occurring in the insulation or vapour barrier.

3.1.12 Priming or painting of insulation will be done under Division 9.

3.1.13 Cover exposed insulation outside the building with 3 mm thick wet coat of Breather Mastic. While wet, embed a layer of Glass Fabric with all joints lapped 50 mm minimum, and cover with a second 3 mm wet coat of Breather Mastic.

3.1.14 Minimum insulation thickness shall conform to ASHRAE 90.1.

3.2 Pipe Insulation

3.2.1 Insulate new piping with rigid pipe insulation as follows:

Service	Operating Temperature Range F (C)	Pipe Diameter in. (mm)	Insulation Thickness in. (mm)
Condensate	0 to 850 (-18 to 454)	All sizes	1/2 (13)
Domestic cold water	0 to 850 (-18 to 454)	All sizes	1(25)
Domestic hot water	105 (41) and higher	2 (50) and smaller 2-1/2 (65) and larger	1 (25) 1-1/2 (40)

3.2.2 Insulate fittings and flanges and pipe connections with insulated fitting covers.

3.2.3 Wrap butt joints with a 4" (100 mm) strip of fire resistant vapour barrier jacket cemented with lagging adhesive.

3.2.4 Where the pipe hanger is around the insulation, provide an insulation protection shield within the pipe saddle. Coordinate with installation of hangers.

3.2.5 Insulate all fittings, flanges and valves on pipes to provide equivalent insulation to that on adjoining pipe.

3.2.6 Continue insulation through sleeves including specified finish.

3.2.7 Protect insulation with protection saddles where insulated pipe is supported by rollers.

3.2.8 Insulate pipe hangers supporting new piping carrying water at 70 F (21 C) or less to prevent condensation. Extend insulating material along hanger rod to height 4 times thickness of insulation. Seal insulation with vapour proof sealant.

3.2.9 Extend pipe insulation and covering through walls, floors, ceilings, and concrete beams, unless indicated otherwise on drawings. protect exposed insulation extending through floors with 4" (100 mm) wide strip of 18 gauge (1.3 mm) galvanized iron.

3.2.10 Pack annular space between pipe sleeves and piping or pipe covering with glass fibre insulation or rockwool insulation. In fire rated assemblies use Dow Silicon RTV or other ULC listed materials. Seal exposed insulation with mastic.

3.3 Refrigeration Pipe Insulation

3.3.1 Insulate all refrigerant suction and hot gas piping and fittings with flexible foamed plastic pipe insulation. Insulation shall fit pipe. Thickness shall be as follows: 1/2" (13 mm) thick for pipe 1" (25 mm) O.D. and smaller; 3/4" (20 mm) thick for pipe 1-1/8" (28 mm) to 2" (50 mm) O.D.; 1" (25 mm) thick for pipes 2-1/8" (54 mm) O.D. and larger.

3.3.2 Slip insulation on to tubing before tubing sections and fittings are assembled. Keep slitting of insulation to a very minimum. Seal all joints in the insulation with Armaflex 520 or BFG Construction Adhesive #105. Insulate flexible pipe connectors.

3.3.3 On insulation exposed outside the building, place "slit" joint seams on bottom of pipe and provide two coats of grey Armaflex finish. Extend insulation through pipe support clamps. Provide a 6" (150 mm) long, 20 gauge (1.1 mm) galvanized steel sleeve around pipe insulation at each support.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install duct insulation.

1.2 Reference Standards

1.2.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-51.9, Mineral Fibre Thermal Insulation for Piping and Round Ducting

.2 CAN/CGSB-51.10, Mineral Fibre Board Thermal Insulation.

.3 CAN/CGSB-51.11, Mineral Fibre Thermal Insulation Blanket.

.4 CAN/CGSB-51.12, Cement, Thermal Insulation and Finishing

.5 CGSB 51-GP-52Ma Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

.6 CGSB 51-GP-53M, Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels and Round Ducts

1.2.2 American Society for Testing and materials (ASTM):

.1 ASTM C 195 Specification for Mineral Fiber Thermal Insulating Cement

.2 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic Setting Thermal Insulating and Finishing Cement

.3 ASTM C 534, Specification for Mineral Fiber Preformed Pipe Insulation

.4 ASTM C553, Specification for Mineral Fiber Blanket and Thermal Insulation for Commercial and Industrial Applications

.5 ASTM C 921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

.6 ASTM E 84, Test Methods for Surface Burning Characteristics of Building Materials

.7 ASTM E 96, Test Methods for Water Vapor Transmission of Materials

.8 ASTM C411-82

1.1.3 Underwriter's Laboratories of Canada (ULC):

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies

1.1.4 Thermal Insulation Association of Canada (TIAC):

.1 TIAC National Insulation Standards, Section 4 Insulation Materials and Properties

.2 TIAC National Insulation Standards, Section 5 Commercial Piping

.3 TIAC National Insulation Standards, Section 13 Installation Details

.4 TIAC National Insulation Standards, Section 14 Glossary and Definitions

1.1.5 Measures for Energy Conservation in New Buildings, Associate Committee of the National Building Code (ACNBC).

1.1.6 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE Standard 90.1

1.2.7 SMACNA:

1.2.8 HVAC Duct Construction Standards - Metal and Flexible.

1.3 Related Sections

1.3.1 Division 9 – Finishes

1.3.2 Section 15010 - Mechanical General Requirements

1.3.3 Section 15100 - Basic Materials and Methods

1.4 Submittals

1.1.7 Submit Shop Drawings in accordance with Section 15010 – Mechanical General Requirements for the following equipment items:

.1 Rigid Duct Insulation

.2 Flexible Duct Insulation

1.5 Definitions

1.1.8 "Concealed" means insulated mechanical services and equipment in trenches, chases, furred spaces, pipe shafts or above suspended ceilings. Services in tunnels will not be considered to be concealed.

1.1.9 "Exposed" will mean "not concealed" as defined herein. The following areas are designated as "exposed" where the term is applied to covering:

.1 Mechanical equipment rooms.

.2 Below suspended ceiling level in occupied areas.

.3 In any occupied area where no ceiling is present or where services and equipment are visible.

.4 Anywhere else indicated on the drawings or in the specifications.

2 PRODUCTS

2.1 Rigid Duct Insulation

2.1.1 Material: fibrous glass wool or mineral wool, density of 3 lb/ft^3 (48 kg/m^3), formed into rigid boards, suitable for maximum operating temperature of 250 F (121 C), and have a maximum average thermal conductivity (k factor) of 0.24 Btu in./hr.ft2 F (0.035 W/m/ C) at a mean temperature of 75 F (24 C) and faced with factory applied RFFRK vapour barrier.

2.1.2 Acceptable products: Owens Corning Fiberglas Inc. Vapour-Seal duct Insulation AF530 with RFRK facing; Manson Insulation Inc. AK Board with FSK facing; Knauf Fibre Glass; Roxul RXL30A-FSK; Schuller; or Agency Approved Equal.

2.2 Flexible Duct Insulation

2.2.1 Material: fibrous glass wool formed into a flexible blanket and faced with reinforced foil-faced flame resistant kraft factory-applied facing, suitable for a maximum average thermal conductivity (k factor) of 0.24 Btu in./hr.ft2 F (0.038 W/m/ C) at a mean temperature of 75 F (24 C), and faced with factory applied vapour barrier.

2.2.2 Acceptable products: Owens Corning Fiberglas Inc.: type 2 with RFFRK; Manson Insulation Inc. Alley-Wrap with FSK; Knauf Fibre Glass; Schuller; or Agency Approved Equal.

2.3 Jackets

2.3.1 Aluminum:

.1 In accordance with ASTM B209M.

.2 Thickness: 0.5 mm sheet.

.3 Finish: Stucco embossed with factory attached protective liner (moisture barrier) on interior surface.

.4 Joining: Longitudinal 2-lock type and circumferential slip joints with 50 mm butt end laps.

.5 Fittings: 0.5 mm thick die shaped fitting covers with factory attached protective liner on interior surface.

.6 Metal jacket banding and mechanical seals: Stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.7 Butt straps: Aluminum with foam strips with peel off tape on both outside edges of inside of strap.

2.4 Fasteners

2.4.1 Tape:

.1 Foil Scrim Kraft (FSK) with self adhesive, 100mm wide rated under 25 for flame spread and under 50 for smoke development.

.2 Acceptable product: Mactac or Agency Approved Equal.

2.4.2 Contact Adhesive:

.1 Quick-setting, non-flammable fire resistive adhesive to adhere fibrous glass to ducts. Flame spread 15 smoke development 0.

.2 Acceptable Product: Foster 85-20 Spark-Fas, Armstrong 520, or Agency Approved Equal.

2.4.3 Lap Seal Adhesive:

.1 Quick-setting adhesive for joints and lap sealing of vapour barriers. Flame spread 10 smoke development 0.

.2 Acceptable Product: Foster 85-75 Drion or Agency Approved Equal.

2.4.4 For Canvas:

.1 Washable adhesive for cementing canvas lagging cloth to duct insulation.

.2 Acceptable Product: Foster 30-36 Sealfas or Agency Approved Equal.

2.4.5 Pins:

.1 Weld pins with 1-1/2" (38mm) diameter head for installation through the insulation. Length to suit thickness of insulation.

.2 Acceptable Product: Duro Dyne AClip-Pin@ or Agency Approved Equal.

.3 Weld pins 1/16" (2mm) for installation prior to applying insulation. Length to exceed thickness of insulation by 1/4" (6mm). Nylon retain clips 1-1/4" (32mm) square.

.4 Acceptable Product: Duro Dyne ASpotter Pins@ with spotter clips or stop clips as required or Agency Approved Equal.

3 EXECUTION

3.1 Examination

3.1.1 Verify that ductwork has been tested according to specifications and as required by agencies having jurisdiction and approved before applying insulation materials.

3.1.2 Verify that all surfaces to be insulated are clean and dry with all foreign materials removed.

3.2 Installation / Application

3.2.1 Install mechanical insulation in accordance with TIAC National Insulation Standards.

3.2.2 Apply all insulation, wrapping, vapour barrier, jacket, adhesives, coatings and cement in strict accordance with manufacturer's installation instructions.

3.2.3 Work shall be performed by insulation journeymen. All work covered under this Section shall be performed in a workmanlike manner, finished to present a neat appearance.

3.2.4 Do not apply insulation and finishing when the ambient temperature is below 10_C in the space.

3.2.5 Use insulation materials on cold piping which are non-hygroscopic and which are complete with a continuous fire-resistant vapour barrier. Maintain uninterrupted continuity and integrity of vapour barrier.

3.2.6 Do not use wheatpaste or any other material that is prone to formation of moulds.

3.2.7 Do not use staples on vapour barriers.

3.2.8 Apply insulation in a manner facilitating the replacement of and/or servicing of equipment.

3.2.9 Terminate insulation neatly around openings and items that require periodic access.

3.2.10 Make good any existing insulation and covering damaged during the work of this Contract, using materials of equal quality as existing.

3.2.11 Make good and refinish cracks, undulations or any other deficiencies occurring in the insulation or vapour barrier.

3.2.12 Priming or painting of insulation will be done under Division 9.

3.2.13 Cover exposed insulation outside the building with aluminum.

3.2.14 Minimum insulation thickness shall conform to ASHRAE 90.1.

3.2.15 Cover exposed insulation inside the building up to 2.4 meters above the finished floor with aluminum.

3.2.16 Cover all exposed insulation inside the prefabricated building with aluminum.

3.3 Duct Insulation

3.3.1 Insulate new ductwork as follows:

Service	Type	Thickness
Air supply rectangular	rigid	1.5" (38mm)
Air supply round	flexible	1.5" (38mm)
Exhaust 6' (2m) from outside) rectangular	rigid	3" (75mm)
Exhaust 6' (2m) from outside) round	flexible	3" (75mm)
Fresh air intake rectangular	rigid	3" (75mm)
Rectangular air supply runouts to terminal units less than 10' (3m) in length	rigid	1.5" (38mm)
Round air supply runouts to terminal units less than 10'(3m) in length	flexible	1.5" (38mm)

3.3.2 Butt joints tightly together and seal with 4" (100mm) wide strips of aluminum foil tape or vapour barrier jacket. Seal joints and laps with vapour-proof adhesive.

3.3.3 Stagger longitudinal and horizontal joints on multi-layered applications.

3.3.4 Recover exposed surfaces of new insulation with 6 oz/sq yd (200 g/m^2) canvas jacket on all ductwork located higher than 2.4 meters above finished floor. Cement canvas to surface of insulation with fireproof adhesive, and finish with heavy brush coat of undiluted fire-proof lagging adhesive.

3.3.5 Secure insulation to flat metal surfaces of ductwork, etc., with 50% coverage of vapour-proof adhesive and weld pins at not more than 8" (200mm) centres, minimum of two (2) rows of pins per side and bottom.

3.3.6 Secure insulation to curved metal surfaces with flame resistant adhesive applied in 4" (100mm) wide bands on 12" (300mm) centres.

3.3.7 Cover angles and standing seams which extend beyond face of applied insulation with 1/2" (13mm) thick blanket of glass fibre insulation fitted with factory applied facing of fire resistant kraft paper. Provide 3" (75mm) overlap on each side of angle or seam. Apply strips of 25mm thick glass fibre insulation board over blanket type insulation, allowing extended portion of angle or seam to project through work.

3.3.8 Seal holes, corners, and joints with 3" (75mm) wide scrim foil tape immediately following application of insulating materials.

3.3.9 Inline supply duct silencers to be insulated to match supply duct insulation.

3.3.10 Where supply ductwork is indicated to be internally lined, the ductwork shall be insulated such that the sum of the insulation and the lining thickness is as indicated in 3.3.a.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers the supply and installation portable fire extinguishers.

1.2 Related Sections

1.2.1 Section 15010 - Mechanical General Requirements.

1.2.2 Section 15100 - Basic Materials and Methods.

1.3 Reference Standards

1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to the following:

.1 NFPA 10

1.4 Submittals

1.4.1 Make submittals in accordance with Division 1

1.4.2 Submit in accordance with Section 15010 - Mechanical General Requirements

1.5 Shop Drawings

1.5.1 Provide shop drawings for the following equipment items:

.1 Fire extinguishers

.2 Fire extinguisher cabinets

2 PRODUCTS

2.1 Portable Fire Extinguishers

2.1.1 Reference Standard: portable extinguishers shall be ULC listed and labelled, and shall be rated and identified in conformance with CAN ULC/S508, "Rating and Fire Testing of Fire Extinguishers".

2.1.2 5 lb. (2.27 kg) multi-purpose (ABC) type, dry chemical minimum rating 3A:10Bc. National Fire Equipment Ltd. model ABC-050.

2.1.3 10 lb. (4.54 kg) multi-purpose (ABC) type, dry chemical minimum rating 4A:60Bc. National Fire Equipment Ltd. model ABC-10.

2.1.4 Portable fire extinguishers shall be provided complete with wall mounting bracket where not installed in cabinets.

2.1.5 Manufacturers:

.1 National Fire Equipment Ltd. indicated.

.2 Kent,

.3 Pyrene Canada Ltd.,

.4 CFH,

.5 Safety Supply,

.6 Chubb,

.7 Or Agency Approved Equal.

3 EXECUTION

3.1 Fire Extinguishers

3.1.1 Provide fire extinguishers as noted on the contract documents.

3.1.2 Provide 10 lb. (4.54 kg) multi-purpose extinguishers.

3.2 Fire Extinguisher Cabinets

3.2.1 Provide fire extinguisher cabinets where indicated and in such a manner that they are easily accessible at all times.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 This section covers the supply and installation of general plumbing as section shown and/or specified. In general, the portions of the work are:

.1 Drainage system,

1.2 Related Sections

1.2.1 Section 15010 - Mechanical General Requirements

1.2.2 Section 15100 - Basic Materials and Methods

1.3 Reference Standards

1.3.1 Ontario Building Code

1.3.2 Regulations of Province, City, or local authority having jurisdiction.

1.4 General

1.4.1 Provide materials, equipment and labour to install plumbing as required by Provincial and local codes as specified herein.

1.4.2 Provide water and drainage connections to equipment specified in other sections of this specification.

1.5 Submittals

1.5.1 Make submittals in accordance with Division 1.

1.5.2 Submit in accordance with Section 15010 - Mechanical General Requirements.

1.6 Quality Assurance

1.6.1 All new equipment shall be CSA approved.

2 PRODUCTS

2.1 Drainage

2.1.1 Provide condensate drainage piping system.

3 EXECUTION

3.1 Installation

3.1.1 Drainage lines shall grade 2% grade unless otherwise shown on drawings.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install domestic water piping systems and appurtenances.

1.2 Reference Standards

1.2.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

.1 Ontario Building Code.

.2 Regulations of Province, City, or local authority having jurisdiction

1.3 Related Sections

1.3.1 Section 15010 - Mechanical General Requirements

1.3.2 Section 15100 - Basic Materials and Methods

1.3.3 Section 15401 - Plumbing General

1.4 Submittals

1.4.1 Submit shop drawings in accordance with Section 15010 - Mechanical General Requirements.

1.4.2 Contractor's Material and Test Certificates.

2 PRODUCTS

2.1 Pipe and Pipe Fittings

2.1.1 Domestic Water Distribution:

.1 Above Floor: Hard temper copper tube, type L, soldered, to ASTM B42-87, with wrought copper and bronze solder joint pressure fittings to ANSI B16.22-1980 or cast bronze solder joint fittings to ANSI B16.18-1973. Piping shall be third party certified and have permanent markings.

.2 Below Floor: soft drawn, seamless open tubing, type K to ASTM B88.

.3 Exposed piping in finished areas shall be chrome plated.

2.2 Exposed Trap Priming lines:

2.2.1 NPS ½ (12 mm):

.1 Soft copper coil seamless copper tube, Type L in accordance with ASTM B88.

2.2.2 Fittings: Cast bronze threaded fittings, Class 125 and 250, in accordance with ASME B16.15.

2.2.3 Joints: Screwed c/w Teflon tape.

2.3 Buried and Embedded Trap Priming lines:

2.3.1 NPS ½ (12 mm):

.1 Cross-Linked Polyethylene (PEX) tubing and fittings for a potable water distribution system., 12 mm dia., 1103 kPa rating at 23°C, in continuous lengths.

.2 Fittings and joints: Brass sweat adaptor connection from copper to PEX. No buried fittings permitted.

.3 All PEX tubing, fittings and fitting assemblies to be by the same manufacturer.

.4 All PEX tubing, PEX rings and PEX fittings from the same manufacturer have been tested together and certified as a system.

2.3.2 Listing:

.1 PEX plumbing CAN/CSA-B137.5 listing for all PEX tubing, fittings, and accessories.

.2 Listed by the NSF International to NSF/ANSI Standard 14 and NSF/ANSI Standard 61 for use in potable water systems.

2.3.3 Product(s) and Manufacturer(s):

.1 Aqua PEX tubing and associated fittings by Uponor Ltd.

.2 Water PEX tubing and associated fittings by Watts.

.3 Or Agency Approved Equal.

2.4 Valves

2.4.1 Isolation Valves:

.1 2" (50mm) and smaller: bronze or brass, 600 psi (4 MPa) WOG ball valve, solder ends and teflon seats.

.1	Crane No. F9222	Red & White 5049A
.2	Jenkins Fig. 202J	Kitz 59
.3	Newman Hattersley 1979	M.A.S. B-4

.2 2-1/2" (65mm) and 3" (75mm): bronze or brass, 400 psi (2.67 MPa) WOG ball valves, solder ends and teflon seats.

.1	Kitz 59	Crane No. F9222
.2	Red & White 5049A	Jenkins Fig. 202J
.3	Newman Hattersley 1979	

2.4.2 Throttling Valves:

.1 2" (50mm) and smaller: bronze or brass, 600 psi (4 MPa) WOG, full port ball valve, solder ends, teflon seats and complete with memory stops.

.1 M.A.S B-4

.2 Crane F9222 Red & White 5049A

.3 Jenkins 202J Kitz 59

.4 Newman Hattersley 1979 Milwaukee BA-155

.2 2-1/2" (65mm) and 3" (75mm): bronze or brass, 400 psi (2.67 MPa) WOG, full port, ball valve, solder ends, teflon seats and complete with memory stops.

.1 Crane F9222 Red & White 5049A

.2 Jenkins 202J Kitz

.3 Newman-Hattersley 1979

2.4.3 Check Valves:

.1 3" (75mm) and smaller: bronze, solder joint, 200 psi (1.38 MPa) WOG swing check valve.

.1 Crane 1075 Red & White 237

.2 Jenkins 997AJ Kitz 23

.3 Newman Hattersley A61 Watts

2.4.4 Drain Cocks: 1/2" (13mm) hose end, ball valve with cap and chain, 600 psi cwp.

.1 Jenkins Fig. 201CJ Crane

.2 Newman Hattersley Red & White

.3 Kitz 6BAC

2.4.5 Backflow Preventer (Reduced Pressure):

.1 Construction: stainless steel rated to 180ºF (82ºC) and supplied with fill port ball valves. The mains body shall be Nylon and the seat disc elastometers shall be silicone. For indoor installation, air gap adapter shall be supplied.

.2 Standard: To CAN/CSA-B64-4, CSA-B64.10-01, ASSE No. 1013, NSF/ANSI 61 and AWWA C511-92.

.3 Acceptable Products:

.1 Zurn.

.2 Watts.

.3 ITT Lawler.

.4 Baukmann.

.5 Febco.

.6 Or Agency Approved Equal.

3 EXECUTION

3.1 Piping Installation

3.1.1 Cooperate with other trades whose work affects or is affected by work of this Section, to ensure satisfactory installation and to avoid delays. Provide all materials to be built-in such as sleeves, anchors, etc., together with accurate dimensions or templates, promptly.

3.1.2 Layout all work accurately, installing piping parallel to lines of building.

3.1.3 Install piping, wherever possible, in partitions and above ceiling. Do not install piping in outside walls unless so shown on drawings. Wrap uninsulated piping in masonry walls with building paper.

3.1.4 Install concealed piping close to building structure to minimize furring dimensions.

3.1.5 Provide adequate space around piping to facilitate application of insulation.

3.1.6 Grade horizontal water distribution piping 1" in 30 feet (3 mm/m), rising in direction of flow, wherever possible. Provide hose end drain valves at all low points and vent valves at high points of systems.

3.1.7 Use dielectric couplings where piping of dissimilar metals connect.

3.1.8 Where piping passes through concrete floors, or walls, sleeves shall be sized to permit the pipe to expand freely without binding or crushing pipe insulation.

3.1.9 Install automatic feed valve on cold water make-up line to new hot water heating system.

3.1.10 Water main will be brought into building to a point 12" (310mm) above floor, capped with a blank flange by trades doing outside services.

3.2 Piping Joints

3.2.1 Make joints in piping installed under this Division using persons familiar with the particular materials being used and in accordance with manufacturer's instructions, and as specified herein.

3.2.2 Use silver solder or Silfos for joining copper water tubing installed below grade, and all copper tubing 4" (100 mm) and larger in size.

3.2.3 Pipe 2-1/2" to 6" (65mm to 150mm): may be installed using mechanical pipe couplings of a bolted type with a central cavity design pressure-responsive gasket along with grooved and

copper fittings, as manufactured by Victaulic Company. Coupling Housings - Shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12) with a copper alkyd enamel paint coating (Style 606) as manufactured by Victaulic Company of America. Gasket - Gaskets shall be moulded of synthetic rubber in a central cavity, pressure-responsive configuration conforming to the copper tube size (CT's) outside diameter and coupling housing, of elastomers have properties as designated in ASTM D-2000. Gaskets supplied for water services from -30EF to +230EF (-34EC to +110EC) shall be a Grade "E" EPDM compound with copper colour code, moulded of materials conforming to ASTM D-2000, designation. 2CA615A15B44F17Z, recommended for hot water service within the specified temperature range, plus a variety of dilute acids, oil-free air, and many chemical services. Not recommended for petroleum services. Flanged Connections - shall be Victaulic Style 641 Vic-Flange adapters, engaging directly into roll grooved copper tube and fittings and bolting directly to ANSI Class 125 cast iron and Class 150 steel flanged components. Installer to supply standard flange bolts. Fittings -fittings shall be Victaulic full flow copper fittings with grooves designed to accept Victaulic grooved end couplings.

3.3 Valves

3.3.1 Use valves of line size unless noted otherwise.

3.3.2 Provide isolating valves in each branch from the main line and where indicated.

3.3.3 Provide isolating valves for all mechanical equipment.

3.3.4 Provide globe valves or ball valves complete with memory stop in locations where valve is to be used for regulating purposes.

3.3.5 Provide 1/2" (13mm) brass hose bibb at any low point of the systems not drainable through the main flow and return piping.

3.3.6 Where new valves are installed to replace existing valves and it is impractical to shutdown and drain the entire system, valves shall be replaced using pipe freezing technique described in 3.1.c. above.

3.4 Testing and Inspection

3.4.1 Test water distribution piping in accordance with Ontario Building Code, Subsection 7.3.7 Testing of Potable Water Systems.

3.4.2 Arrange and pay for inspections by the Local Inspection Authority.

3.5 Water Meter

3.5.1 Arrange for and co-ordinate the supply and installation of water meter with the authority having jurisdiction.

END OF SECTION

1 GENERAL

1.1 Related Sections

1.1.1 Section 15010 - Mechanical General Requirements.

1.1.2 Section 15100 - Basic Materials and Methods.

1.2 Scope

1.2.1 This section covers the supply and installation of drainage, waste and vent systems as shown and/or specified. In general, this includes:

.1 Condensate and Sanitary Drainage,

1.3 Reference Standards

1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

.1 Local and district by-laws, regulations, and published engineering standards.

.2 The Ontario Building Code (Ontario Regulation 413/90) and Amending O.Reg. 400/91. 158/93 and 160/93 which includes Part 7 Plumbing.

1.3.2 Conform to following CSA Standards:

.1 CAN/CSA-B70-M91: Cast iron soil pipe, fittings and means of joining.

.2 B158.1-1976: Cast brass solder joint drainage, waste and vent fittings.

.3 CAN/CSA-B181.1-M90: ABS drain, waste and vent pipe and pipe fittings.

.4 CAN/CSA-B181.2-M90: PVC drain, waste and vent pipe and pipe fittings.

.5 CAN/CSA-B181.3: Polyolefin laboratory drainage systems.

.6 CAN/CSA-B182.1-M92: Plastic drain and sewer pipe and pipe fittings.

1.3.3 Conform to following National Research Council Canada publications:

.1 NRCC No. 30619, National Building Code of Canada 1990 and NRCC No. 30629, Supplement to National Building Code of Canada 1990.

.2 NRCC No. 30625, Canadian Plumbing Code 1990.

1.4 Submittals

1.4.1 Make submittals in accordance with Division 1.

1.4.2 Submit in accordance with Section 15010 - Mechanical General Requirements.

1.4.3 Contractor's Material and Test Certificates.

2 PRODUCTS

2.1 Pipe and Pipe Fittings

2.1.1 Sanitary Drainage

.1 Unburied Sections

.1 2" (50 mm) and smaller diameter, hard temper copper tube, type DWV, to ASTM B306-86, soldered, with wrought copper or copper drainage fittings to ANSI B16.29-1980 or cast brass drainage fittings to CSA B158.1-1976.

.2 3" (75 mm) and larger diameter, cast iron soil pipe, 4000# (18 kN) crush strength to ASTM A74-87, no-hub mechanical joint with neoprene gaskets and stainless steel pipe clamps with cast iron drainage fittings to CAN3-B70-M86.

.2 Buried Sections

.1 2" (50 mm) and smaller diameter, hard temper copper pipe, type L, to ASTM B42-87, with wrought copper or copper alloy solder joint to ANSI B16.29-73 or cast brass solder joint to CSA B158.1-1976.

.2 3" (75 mm) and larger diameter, cast iron soil pipe, 4000# (18 kN) crush strength to ASTM A74-87, no-hub mechanical joint with neoprene gaskets and stainless steel pipe clamps with cast iron drainage fittings to CAN3-B70-M86.

.3 75mm (3") and larger diameter, PSM Poly (Vinyl Chloride) (PVC) gravity sewer pipe to CAN/CSA B181.2-M90, CAN/CSA B182.1, CAN/CSA B192.2-M87 and ASTM D30340-85b with DR of 35 maximum. Include rubber ring gaskets. Solvent cement to ASTM D2564-84.

2.1.2 Vent:

.1 Unburied Sections:

.1 All pipe diameters, cast iron soil pipe, 4000# (18 kN) crush strength to ASTM A74-87, no hub mechanical joint with cast iron drainage fittings to CAN3-B70.

.2 Buried Sections:

.1 All pipe diameters, cast iron soil pipe, 4000# (18 kN) crush strength to ASTM A74-87, no hub mechanical joint with cast iron drainage fittings to CAN3-B70-86.

.2 40mm (1 1/2") and larger diameter, PVC-DWV pipe and fittings certified to CAN/CSA-B-181.2-M90, PVC primer and PVC solvent cement to ASTM D2564-84, DR of 35 maximum.

2.1.3 Condensate Drains

.1 Condensate Drain Lines: 3/4" (20 mm) and 1" (25 mm) type M copper, 1-1/4" (32 mm) and larger annealed copper tubing, type DWV, to ASTM B306-86, soldered, with wrought copper or copper alloy drainage fittings to ANSI B16.29-1980 or cast brass drainage fittings to B158.1-1976.

3 EXECUTION

3.1 Piping Installation - Above Ground

3.1.1 Cooperate with other trades whose work affects or is affected by work of this Section, to ensure satisfactory installation and to avoid delays. Provide all materials to be built-in such as sleeves, anchors, etc., together with accurate dimensions or templates, promptly.

3.1.2 Layout all work accurately, installing piping parallel to lines of building.

3.1.3 Install concealed piping close to building structure to minimize furring dimensions.

3.1.4 Grade horizontal drainage piping 1" in 4 feet (20 mm/m) for piping 3" (75 mm) and smaller and 1" in 8 feet (10 mm/m) for piping larger than 3" (75 mm) wherever possible.

3.1.5 Where piping passes through concrete floors, or walls, sleeves shall be sized to permit the pipe to expand freely without binding or crushing pipe insulation.

3.1.6 Provide trapped condensate drain from each air conditioning unit.

3.2 Piping Joints

3.2.1 Make joints in piping installed under this Division using persons familiar with the particular materials being used and in accordance with manufacturer's instructions, and as specified herein.

3.2.2 Use 95/5 Sb.Sn (tin-antimony) solder for joining copper drainage tubing smaller than 4" (100 mm).

3.2.3 Make joints in cast iron pipe with standard M-J joints in accordance with manufacturer's recommendations and CSA B70-M86.

3.3 Testing and Inspection

3.3.1 Test drainage and vent piping in accordance with Plumbing Code, Ontario Building Code Subsection 7.3.6 Testing of Drainage and Venting Systems.

3.3.2 Arrange and pay for inspections by the Local Inspection Authority.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install plumbing specialties and appurtenances.

1.2 Reference Standards

1.2.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

.1 Ontario Building Code.

.2 Regulations of Province, City, or local authority having jurisdiction

.3 CAN3-B79-M79 Floor Drains and Trench Drains

1.3 Related Sections

1.3.1 Section 15010 - Mechanical General Requirements

1.3.2 Section 15100 - Basic Materials and Methods

1.3.3 Section 15401 - Plumbing General

1.4 Submittals

Submit shop drawings in accordance with Section 15010 – Mechanical General Requirements.

2 PRODUCTS

2.1 General

2.1.1 All plumbing specialties supplied shall be manufactured by the same manufacturer.

2.1.2 Descriptions indicated refer to products manufactured by Watts. Equivalent products manufactured by MIFAB, Zurn, J.R. Smith or Agency Approved Equal will be acceptable, subject to shop drawing review.

2.2 Cleanouts (CO)

2.2.1 Underfloor: lacquered or epoxy coated cast iron body, neoprene secondary sealing "O" ring, adjustable epoxy coated nickel bronze frame, 1/2" (13mm) thick gasketed clear epoxy coated polished nickel bronze combined access cover and plug as follows:

Floor Finish	Style	WATTS	Zurn	J.R. Smith	MIFAB
Concrete	round square	CO-200-R-1 CO-200-S-1	ZN1602 ZN1602-T	SQ-4-1753-NBCO-SP SQ-4-1753-SQNBCO-SP	C1100-R-1 C1100-S-1

Floor Finish	Style	WATTS	Zurn	J.R. Smith	MIFAB
Quarry tile	round square	CO-200-R-1 CO-200-S-1	ZN1602-X ZN1602-TX	4180s 4200s	C1230-1
Resilient floor tile	round square	CO-200-T-1 CO-200-TS-1	ZN1602-CM	SQ-4-1753-CO-RT-NB-S	C1100-T-1 C1100-TS-1
Carpet	round	CO-200-RC-1	ZN1602-CM	SQ-4-1753-NBCO-Y-SP	C1100-RC-1
Surface Membrane	round	CO-100-C-RFC		2051-CO-SP	C1100-FC7-1

2.2.2 Line Cleanouts: All lacquered cast iron Malcolm type cleanout ferrule, 1/2" (13mm) thick, epoxy coated gasketed cover:

Separate Access Available	Access Required
Watts CO-450	Watts CO-450-RD-3
Zurn Z1616	Zurn Z1446
J.R. Smith 4420	J.R. Smith 4422
MIFAB	MIFAB CA1450-RD

2.2.3 Stack Cleanouts: lacquered cleanout tee with gasketed cover:

.1 Watts C0-460 MIFAB C1460-RD Zurn Z1446-4NH J.R. Smith 4530

Wall Finish	Access Cover
Tile	7" (180 mm) round stainless steel (RD)
Masonry	7" (180 mm) round stainless steel (RD)
Other	refer to Section 15100 Basic Materials & Methods

2.2.4 Access covers:

.1 Wall access: face or wall type, polished nickel bronze or stainless-steel square and/or round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

2.2.5 Floor access: round cast iron body and frame with adjustable secured nickel bronze top and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for unfinished concrete floors: cast iron round, gasket, vandal-proof screws.

.3 Cover for terrazzo finish: polished nickel, bronze or brass with recessed cover for filling with terrazzo, vandal-proof locking screws.

.4 Cover for tile and linoleum floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

.5 Cover for carpeted floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.3 Floor Drains (FD/FFD/HD/)

2.3.1 Floor Drains in Finished Areas: lacquered or epoxy coated cast iron body with anchor flange, seepage collection sump, nickel bronze strainer:

.1 Floor Drains for Non-Membrane Floors: weepholes, serrated anchor flange, 5" (127 mm) heavy duty strainer:

.1 Watts FD-200

.2 MIFAB F1000-5-3

.3 Zurn ZXN211-A5-P

.4 J.R. Smith SQ-4-1753-05NBHD

.5 Or Agency Approved Equal

.2 Hub Drain for Non-Membrane Floors: Weepholes, nickel bronze indirect waste hub 5" (125mm) dia.:

.1 Watts FD-200-DD

.2 MIFAB F1000-DD-3

.3 Zurn ZN211-S-P w. Nickel Bronze Funnel

.4 J.R. Smith SQ-4-1753-2645NB

.5 Or Agency Approved Equal

.3 Funnel Floor Drain For Non-Membrane Floors: weepholes, 4" x 9" (100 x 225mm) full opening elongated funnel:

.1 Watts FD-200-EG

.2 MIFAB F1000-EG

.3 Zurn ZX211-BF w. Cast Iron Funnel

.4 J.R. Smith SQ-4-1753-A05NB-OT-3591NB

.5 Or Agency Approved Equal

2.4 Area Drains (AD)

Area Drain for screen washdown troughs: 15” square adjustable top, epoxy coated cast iron, square epoxy coated ductile iron tractor grate, 6” pipe size.

.1 Watts FD-450-AF

.2 Or Agency Approved Equal

2.5 Trap Seal Primers (TSP)

2.5.1 Individual traps: automatic, renewable disc and seat rings, vacuum breaker, and removable cover:

.1 Watts MS-810

.2 MIFAB M1-100

.3 Zurn Z1022-XL

.4 J.R. Smith 2699LF

.5 Or Agency Approved Equal

2.5.2 Groups of traps: Electronic manifold, type AL@ copper, anti-siphon atmospheric vacuum breaker, water hammer arrestor, 120V solenoid valve, circuit breaker, switch, timer. Assembly housed in 16-gauge steel cabinet, with 14” x 16" stainless steel access door:

.1 Precision Plumbing Products PT Series

.2 MIFAB MI-100 Series

.3 Zurn Z1020

.4 Or Agency Approved Equal

2.6 Water Hammer Arrestors (WHA)

2.6.1 Hard drawn copper construction with precharged air chamber, Delrin PL pistons with Buna N "O" rings sized in accordance with manufacturer's recommendations:

.1 Watts "Shok-gard" SG

.2 Zurn 1250XL

.3 Amtrol

.4 MIFAB

.5 PPP

.6 J.R. Smith 5200 SERIES

.7 Or Agency Approved Equal

2.7 Non-Freeze Wall Hydrants (NFWH)

2.7.1 Exterior: 38 mm connection size, non-freeze type with chrome-plated bronze box and cover for recessed installation, self draining, removable operating key, and vacuum breaker:

.1 Watts HY-725

.2 Zurn Z1320-XL

.3 MIFAB MHY-20

.4 J.R. Smith 5509QT-CP

.5 Or Agency Approved Equal

2.8 Hose Bibbs

2.8.1 Stainless steel construction, 19mm, complete with hose thread spout, and tee handle.

2.8.2 Reduced pressure principal type conforming to the latest revision of AWWA C511 and CSA-B64.

2.8.3 Complete with isolation valves, strainer and blow-off valve and air gap funnel.

2.8.4 Reduced pressure principal type:

.1 Acceptable Suppliers:

.1 Watts

.2 Zurn

.3 J.R. Smith

.4 Agency Approved Equal

2.9 Hose Reel Station

2.9.1 Heavy-Duty Dual-Pedestal Hose Reel, c/w spring retractable Reels.

2.9.2 Steel construction and a baked-on powder coat finish. Rugged and corrosion resistant.

2.9.3 One piece guide roller, stainless steel pin, aluminum hub and two sealed ball bearings.

2.9.4 Drive type: Spring Return.

2.9.5 Guide arm to be adjustable in different positions.

2.9.6 Hose Reel Station shall be supplied, equipped with 30m (100 foot) long hose with spray gun/wand assembly (trigger gun – Suttner model ST2605 gun), couplings thread for spray gun leak-proof connection, wall/column swing bracket.

.1 Water supply hose shall be 12.7mm (1/2 inch) ID rubber hose. Spray hose shall be 10mm (3/8 inch) ID wire braid hose. The hose shall be provided with suitable hose connector. An insulated heavy-duty trigger gun shall also be provided with the unit.

2.9.7 Acceptable Manufactures:

.1 Reelcraft

.2 Coxreels

.3 Or Agency Approved Equal

2.10 Vacuum Breakers

2.10.1 To CSA-B64 Series.

2.10.2 Atmospheric vacuum breaker:

.1 Acceptable Suppliers:

.1 Watts Series 288A

.2 Or Agency Approved Equal

2.10.3 Hose connection vacuum breaker:

.1 Acceptable material:

.1 Watts Series 8

.2 or Agency Approved Equal

2.11 Trench Drain

2.11.1 General:

.1 Standard 80” (2031mm) long, 6 1-4” (159mm) wide reveal and a 4” (102mm) throat.

.2 Modular channel sections shall be made of 0% water absorbent High Density Polyethylene (HDPE).

.3 Channels shall have a positive mechanical connection between channel sections that will not separate during the installation and mechanically lock into the concrete surround a minimum of every 10" (254mm).

.4 Channels weigh shall be less than 2.31 lbs. per linear foot (3.9 kg/m), have a smooth, 1-1/2" (38mm) radiused self cleaning bottom with a Manning’s coefficient of .009 and .75% built in slope.

.5 Channels shall have rebar clips standard to secure trench in its final location.

.6 Channels shall be provided with standard DGC grates that lock down with lockdown bars to the channel and to be not intended for dynamic traffic loadings.

.7 Acceptable Model: Zurn Z886.

2.11.2 Grate:

.1 5-3/8" (137mm) wide reveal Ductile Iron Slotted Grate conforming to ASTM specification A536-84, Grade 80-55-06.

.2 Ductile Iron grate shall be rated class C per the DIN EN1433 top load classifications.

.3 Supplied in 20" (508mm) nominal lengths with 1/2" (13mm) wide slots, and 3/4" (19mm) bearing depth.

.4 Grate has an open area of 28.1 sq. in per ft. (60,308 sq. mm per meter).

2.11.3 Accessories:

.1 Closed End Cap.

2.12 Trench Drain and Catch Basin (Pre-fabricated Building)

2.12.1 6" wide trench system

.1 Watts #P Trench Drain (or Agency Approved Equal)

.2 UV stabilized talc-filled polypropylene channels with integral 4" (102 mm) and 6" (152 mm) no hub bottom outlets, pre-sloped trench, 6" (152 mm) wide, 48" (1219 mm) long, including frame connectors, grate lockdowns and construction covers, UV stabilized glass-filled polypropylene frame, framed anchored grate, closed end cap.

2.12.2 Dead level trench drain system catch basin

.1 Watts #CB-2412 Trench Drain Catch Basin (or Agency Approved Equal)

.2 UV stabilized talc-filled polypropylene channels with integral 4" (102 mm) and 6" (152 mm) no hub bottom or side outlet as required, 12" (305 mm) wide, 24" (610 mm) long, frame-anchored with specified grating and lockdowns to suit DIN class load rating, ductile iron frame, framed anchored grate, and sediment bucket.

3 EXECUTION

3.1 Cleanouts

3.1.1 Cleanouts shall be the same size as pipe up to 4" (100mm) and not less than 4" (100mm) for larger pipes.

3.1.2 Provide cleanouts at the end of mains and branches, at changes in direction, in long straight runs, at the base of all soil stacks and rainwater leaders and where required by code.

3.1.3 Use extended cleanouts for piping installed below grade and in furred ceiling spaces.

3.1.4 On floors with surface waterproofing membranes use only cleanouts with surface membrane clamp and anchoring flange. It is not acceptable to cut out around the cleanout and glue the membrane to the floor.

3.2 Floor Drains

3.2.1 Provide drains, complete with traps, where shown on drawings.

3.2.2 Embed traps and floor drains protruding below concrete slabs on grade entirely in concrete. Piping passing through such floors shall be surrounded with sufficient concrete to make the installation watertight and prevent ground water from seeping between the metal and concrete into the rooms.

3.2.3 Provide trap seal primers and supply lines to each drains trap.

3.2.4 On floors with surface waterproofing membranes use only floor drains with surface membrane clamps and anchoring flange. It is not acceptable to cut out around the drain and glue the membrane to the floor.

3.3 Wall Hydrants

3.3.1 Locate wall hydrants as indicated.

3.4 Roof Drains

3.4.1 Provide roof drains were shown on drawings. Co-ordinate this work with the roofing contractor.

3.5 Water Hammer Arrestors

3.5.1 Provide water hammer arrestors ahead of each plumbing fixture or fixture group utilizing solenoid valves, flush valves, or other quick closing valves and wherever else necessary to prevent water hammer.

3.6 Backflow Preventers

3.6.1 Install in accordance with CAN/CSA-B64 Series, where indicated and elsewhere as required by code.

3.6.2 Pipe discharge to terminate over nearest drain or service sink.

3.7 Acid Neutralizing Tank

3.7.1 Install in accordance with manufacturer’s instructions.

3.7.2 Provide sufficient clearance for cover removal and piping connections.

3.8 Trench Drains

3.8.1 Install to manufacturer’s written instructions, reviewed shop drawings and Contract Drawings.

3.8.2 Set top of gratings and frames flush with floor slab.

3.8.3 Excavate beneath trench drains to maintain concrete floor slab thickness as indicated on Contract Drawings.

3.8.4 During concrete pouring, ensure full contact between concrete and trench drain channel and frame. Remove all air pockets and voids.

3.8.5 Provide temporary cover over trench drain openings during construction procedures. Keep debris out.

3.8.6 Clean channels of all debris prior to final placement of gratings.

3.8.7 Hand frames to concrete trades forming and pouring the trenches. Ensure that frames are properly and accurately installed. Temporarily cover trench drainage openings during construction procedures. Clean trenches when work is complete.

3.8.8 Install grates and secure in place.

3.9 Start-up

3.9.1 Floor drains:

.1 Prime, using trap primer.

.2 Clean out baskets.

3.9.2 Rectify start-up deficiencies.

3.10 Commissioning

3.10.1 In context of this paragraph, "verify" to include "demonstrate" to the Contract Administrator.

3.10.2 Timing: commission only after start-up deficiencies rectified.

3.10.3 Access doors: verify size and location relative to items to be services.

3.10.4 Adjust to suit site conditions, including, but not necessarily limited to, following:

.1 Floor drains/trench drains:

.1 Verify proper operation of trap primer, flushing features.

.2 Verify security and removability of strainers / grating.

.2 Cleanouts:

.1 Verify covers are gas tight, secure and easily removable.

.2 Verify that cleanout rods can probe as far as next cleanout.

.3 Backflow preventers, vacuum breakers:

.1 Verify installation of correct type to suit application.

.2 Adjust as necessary to ensure proper operation.

.3 Verify visibility of discharge.

.4 Wall hydrants:

.1 Verify Operation.

.5 Trap seal primers:

.1 Verify operation.

.2 Adjust flow rate to suit site conditions.

3.10.5 Commissioning reports:

.1 Record all results on approved report forms.

.2 Include signature of tester and supervisor.

.3 To be countersigned by the Contract Administrator.

3.10.6 Verification:

.1 Notify the Contract Administrator 2 working days before commencing tests.

.2 All tests and procedures to be witnessed by the Contract Administrator.

3.10.7 Demonstration and Training:

.1 Train O&M personnel in start-up, operation, monitoring, servicing, maintenance and shut-down procedures.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install plumbing fixtures and associated trim.

1.2 References

1.2.1 CAN/CSA-B45.0-02 - General Requirements for Plumbing Fixtures

1.2.2 CAN/CSA-B125.3-12 - Plumbing Fittings

1.2.3 ANSI/ISEA Z358.1, Emergency Eyewash and Shower Equipment.

1.2.4 ANSI Z358.1-2024

1.3 Related Sections

1.3.1 Section 01330 – Submittals

1.3.2 Section 01780 – Closeout Submittals

1.3.3 Section 15010 - Mechanical General Requirements

1.3.4 Section 15100 - Basic Materials and Methods

1.4 Submittals

1.4.1 Submit shop drawings and product data in accordance with Section 01330 – Submittals.

1.4.2 Submit shop drawings in accordance with Section 15010 – Mechanical General Requirements.

1.5 Maintenance Data

1.5.1 Provide maintenance data for incorporation into manual specified in Section 01780 – Closeout Submittals.

1.5.2 Data to include:

.1 Description of fixtures and trim, giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

2 PRODUCTS

2.1 Eye/Face Wash Station

2.1.1 Eye/Face and shower

.1 Wall mounted unit with stainless steel bowl, chrome plated brass piping, ABS plastic dual stream heads with ABS plastic float-off covers. Stainless steel push plate (with actuation graphics) to operate stay open ball valve, 32 mm diameter supply and 32 mm diameter waste connection, wall bracket to suit. In combination with emergency shower consisting of yellow ABS coated Schedule 80 galvanized steel pipe assembly, 76 L/min at 29°C for 15 minutes, high visibility ABS plastic shower head, and stainless steel pull chain operated valve.

.2 Standard of Acceptance

.1 Encon 01050277

.2 Acorn S1320

.3 Haws 8300-8309

.4 Or Agency Approved Equal

.3 Ball type shut-off valve in tempered water supply piping.

.4 P-trap: Chrome plated brass 32 mm diameter adjustable with cleanout plug.

.5 Flow Switch. Supplied and installed by Division 15, wired to SCADA by Division 16.

2.1.2 Eye/Face wash water tempering valve station

.1 Wall mounted hot and cold water blending unit, enclosed in stainless steel cabinet with integral wall support. Pre set non-adjustable utilization temperature. Mixing valve to be equipped with internal cold water bypass 76 L/min upon failure of hot water supply and to close down upon failure of cold water supply. Unit capable of supplying 220 L/min tempered water at 29°C for 15 minutes.

.2 Standard of Acceptance

.1 Leonard TM 600-STSTL-EXP

.2 Acorn ET71-2-OTG-ASVB-2-SSTL

.3 Haws 9201EW

.4 Or Agency Approved Equal

3 EXECUTION

3.1 Installation

3.1.1 Connect fixtures complete with supplies and drains, trapped, supported level and square, hot water faucets shall be on left. Fixtures on outside walls to have supplies from floor; or as indicated on drawings, other fixtures to be served from wall.

3.1.2 Mounting heights.

.1 Standard: to comply with manufacturer’s recommendations unless otherwise indicated or specified.

.2 Barrier Free: to comply with most stringent of either NBCC or CAN/CSA B651.

3.1.3 Provide and secure in place fixture carriers for wall hung and semi-countertop mounted fixtures while walls are being constructed.

3.1.4 Verify locations of plumbing fixtures with Architectural floor plans and confirm mounting heights with Consultant prior to installation.

3.1.5 Install plumbing fixtures level and plumb relative to finished floors and/or wall surfaces.

3.1.6 Accurately lay out all roughing-in as no offsets will be accepted.

3.1.7 Use chrome plated items for all visible parts of the fixture trim including faucets, escutcheons, waste, strainers, traps, supplies, stops, etc.

3.1.8 Provide and install all accessories and optional features indicated to be supplied with fixtures.

3.1.9 On completion, set temperature limit stop for a maximum temperature of 110 F (42°C) following manufacturer's installation instructions on pressure balancing valves in showers.

3.1.10 Provide offset wastes for all fixtures designated for handicapped application to allow for required clearance under fixture.

3.2 Eye/Face Wash Station

3.2.1 Wall mount eye/face/shower water tempering valve assembly where indicated. Set maximum temperature limit stop to deliver 30°C water. Set mixing valve to deliver 25°C and confirm proper operation.

3.2.2 Secure eye/face/shower assembly to floor in accordance with manufacturer's installation instructions.

3.3 Thermostatic Mixing Valves

3.3.1 Provide thermostatic mixing valves as indicated and following manufacturer's installation instructions.

3.3.2 Verify temperature settings, operation of control, limit and safety controls.

3.3.3 Make all necessary piping connections.

3.4 Adjusting

3.4.1 Conform to water conservation requirements specified this section.

3.4.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

3.4.3 Checks:

.1 Aerators: operation, cleanliness.

.2 Vacuum breakers, backflow preventers: operation under all conditions.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install plumbing fixtures and trim, gas fired hot water tanks and electric hot water tanks.

1.2 Reference Standards

1.2.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

.1 ANSI Z21.10.3/CSA 4.3

.2 ASME – American Society of Mechanical Engineers

.3 ASHRAE 90.1.

.4 CAN/CSA-C22.2 No. 110

.5 CAN/CSA-C191

.6 CSA B149.1

.7 OBC, Ontario Building Code

.8 OESC, Ontario Electrical Safety Code

.9 CSA - Canadian Standards Association

.10 UL, Underwriters Laboratories

1.3 Related Sections

1.3.1 Section 15010 - Mechanical General Requirements

1.3.2 Section 15100 - Basic Materials and Methods

1.3.3 Section 15401 - Plumbing General

1.4 Submittals

1.4.1 Submit shop drawings in accordance with Section 15010 – Mechanical General Requirements.

2 PRODUCTS

2.1 Electric Water Heater

2.1.1 Manufacturer: AO Smith, corrosion resistant hot water tank, model DRE-120, 450 Litre (119 USG) tank capacity, input capacity of 12kW.

2.1.2 Other acceptable manufacturers offering equivalent products:

.1 Substitutions: Refer to Section 15010 – Mechanical General Requirements.

2.1.3 The tank shall be HydraStone cement lining and high impact composite jacket that cannot rust or corrode.

2.1.4 The heater shall have 3” (75mm) Non-CFC (Chlorofluorocarbons) foam insulation and come with an ASME rated T&P relief valve..

2.1.5 Heater shall be design certified for 180 ºF (82 ºC) application.

2.2 Thermal Expansion Tank

2.2.1 Refer to the contract drawings for thermal expansion tank installation detail.

2.2.2 Contractor is to install tank in accordance with the manufacturer recommendations and the latest plumbing code.

2.2.3 Tank shall be a commercial tank (ASME Code):

.1 Acceptable Supplier:

.1 Watts Model DETA-20, tank volume of 36.4 L (8 Gal).

.2 Agency Approved Equal

2.3 Backflow Preventers

2.3.1 Reduced pressure principle type conforming to the latest revision of AWWA C511 and CSA-B64.

2.3.2 Complete with isolation valves, strainer, and air gap funnel.

2.3.3 Size and location as shown on the contract drawings.

2.3.4 Reduced pressure principle type and acceptable suppliers:

.1 Watts Series 909.

.2 Clayton and Fabco

.3 Or Agency Approved Equal.

3 EXECUTION

3.1 Domestic Water Heating System

3.1.1 Provide domestic water heater, all pipe, pipe fittings, valves, gauges, etc. indicated.

3.1.2 Co-ordinate the supply of required temperature and pressure relief valves with equipment manufacturers.

3.1.3 Adjust tank rotation and location to ensure relief valves, electrical connections, nameplates, and access covers remain accessible.

3.1.4 Install in accordance with manufacturer's instructions, OBC Part 7 and OESC.

3.1.5 Pipe relief valves to drain.

3.1.6 Provide isolation valves at each tank water inlet and outlet.

3.1.7 Install temperature and pressure gauges on outlet of each tank.

3.2 Commissioning

3.2.1 Verify operational performance:

.1 Adequate hot water supply for required duration for emergency eyewash, facewash, and shower stations.

.2 Recovery time in accordance with schedule.

.3 Function of heater and associated controls.

.4 Water supply temperature and set point.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install electric heaters and associated controls.

1.2 Related Sections

1.2.1 Section 15010 - Mechanical General Requirements

1.2.2 Section 15100 - Basic Materials and Methods

1.2.3 Section 15900 - HVAC Controls

1.2.4 Division 16 - Electrical

1.3 Reference Standards

1.3.1 CSA (Canadian Standards Association)

1.3.2 ULC (Underwriters Laboratories of Canada)

1.4 Submittals

1.4.1 Submit in accordance with Division 1.

1.4.2 Submit in accordance with Section 15010 - Mechanical General Requirements

1.5 Shop Drawings

1.5.1 Submit shop drawings indicating:

.1 Product Data: Provide manufacturers literature and data indicating electrical characteristics.

.2 Performance criteria, compliance with appropriate reference standards, characteristics, limitations, troubleshooting protocol.

.3 Information sufficient and clearly marked to demonstrate that the system, including all specified arrangements, options and accessories will be supplied, including but not limited to:

.1 Unit model, size capacity, and efficiency.

.2 Electrical characteristics.

.3 Thermostat and other control devices.

1.5.2 Fittings, control equipment and accessories shipped loose, showing final location in assembly.

1.5.3 Wiring diagrams including complete internal panel wiring, external panel wiring and field wiring.

1.5.4 Dimensions, internal and external construction details, recommended method of installation.

1.5.5 Performance data.

1.5.6 Submittals for Information

.1 Installation Data: Manufacturer's special installation requirements including procedures required for mounting and making service connections.

1.6 Closeout Submittals

1.6.1 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6.2 Warranty Documentation: The contractor shall provide a written warranty providing all labour and parts for a minimum of one year after substantial completion.

1.7 Warranty

1.7.1 Provide one (1) year on all parts and labour.

2 PRODUCTS

2.1 Unit Heater:

2.1.1 Unit Heaters:

.1 Casing: 1.2mm thick (18 ga) steel, with gloss enamel finish and threaded connections for hanger rods.

.2 Electric Coils: constructed from seamless copper tubing, silver brazed to steel headers with evenly spaced aluminum fins mechanically bonded to tubing and leak tested 1000pa with air under water.

.3 Fan: Propeller type, dynamically and statically balanced, with fan guard.

.4 Motor: Continuous duty, built in overload protection, and resilient motor supports, permanently lubricated ball bearings.

.5 Air outlet: Individually adjustable louvres.

.6 Capacity: As indicated.

.7 Controls:

.1 Remote thermostats.

.2 120 V control circuit with magnetic contactor and transformer.

.3 Built-in disconnect switch.

.8 Mounting bracket or hanger rods (refer to drawings for support required).

2.2 Manufacturers

2.2.1 Acceptable manufacturers:

.1 Ouellet,

.2 Chromalox,

.3 Stelpro,

.4 CCI Thermal Technologies,

.5 Or Agency Approved Equal.

2.3 Controls:

2.3.1 Unless otherwise indicated, provide a remote wall mounted thermostat for all unit and convector heaters applications. A unit or convector heater mounted thermostat is not acceptable:

.1 A remote thermostat provide by the same manufacturer as the heater is acceptable.

2.3.2 Remote thermostat shall be wired to the unit. Coordinate with Division 16, Electrical to provide complete wiring include power and controls to the thermostat as required. If thermostat cannot be powered from the unit (heater) than coordinate with Division 16, Electrical to provide power from an electrical panel at no extra cost to the project.

2.4 Vertical Unit Heater:

.1 Casing: 20-gauge steel, epoxy-polyester powder-coated finish for durability and corrosion resistance.

.2 Air outlet: Without cone.

.3 Heating Element: High-quality, nichrome wire element for fast and efficient heat transfer.

.4 Fan Motor: Quiet and maintenance-free, permanently lubricated motor.

.5 Controls:

.1 Remote thermostats.

.2 120 V control circuit with magnetic contactor and transformer.

.3 Built-in disconnect switch.

2.5 Controls:

2.5.1 Unless otherwise indicated, provide a remote wall mounted thermostat for all unit and convector heaters applications. A unit or convector heater mounted thermostat is not acceptable:

.1 A remote thermostat provide by the same manufacturer as the heater is acceptable.

2.5.2 Remote thermostat shall be wired to the unit. Coordinate with Division 16, Electrical to provide complete wiring include power and controls to the thermostat as required. If thermostat cannot be powered from the unit (heater) than coordinate with Division 16, Electrical to provide power from an electrical panel at no extra cost to the project.

2.6 Manufacturers

2.6.1 Acceptable manufacturers:

.1 Ouellet,

.2 Or Agency Approved Equal.

2.7 Duct Electric Heater

.1 Industrial flanged duct heater for horizontal ductwork.

.2 Electric elements: Open coil, 80% Nickel, 20 % Chrome resistance wire coils.

.3 Heater frames and terminal boxes shall be galvanized or stainless corrosion resistant steel.

.4 Bolt heater to ductwork and provide additional support steel and seals for all joints with ductwork.

.5 Terminal box: NEMA 1 enclosure, NEMA 1 type construction, hinged, latching cover and multiple concentric knockouts to accept field wiring. All internal wiring to be complete with 105°C rated insulation.

2.8 Controls:

.1 S.C.R. modulating controller.

.2 Wall mount adjustable low voltage thermostat wired to terminal box.

.3 Built-in disconnect and thermal protection with automatic reset.

.4 Supply and install ancillary relays and 24 V control power transformers to facilitate interlocking electric heaters with thermostat and signal from associated supply fan unit as indicated on Contract Drawings.

2.9 Manufacturer(s) and Product(s):

.1 Type QUZ, by Indeeco, LLC.

.2 Type DH, by Chromalox, Inc.

.3 Model FC, by Thermolec, Ltd.

.4 Duct electric heater, by Neptronic.

3 EXECUTION

3.1 Examination

3.1.1 Review proposed locations on-site and co-ordinate installation requirements with general trades, architectural finishes, and power requirements.

3.2 Installation

3.2.1 Install in accordance with manufacturer's instructions.

3.2.2 Check final location with Engineer if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Engineer's direction.

3.2.3 Provide supplementary suspension steel as required.

3.2.4 Install thermostats in locations indicated.

3.2.5 Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.2.6 Coordinate location of wall mount thermostat with furniture layout. Install thermostats in locations shown on drawings.

3.2.7 Make control connections.

3.2.8 Coordinate location for power feed with Division 16, remove knock outs and insert insulating bushing.

3.3 Startup and Commissioning

3.3.1 Verify operational performance in general conformance with the following outline:

.1 Operational performance outline:

.1 Thermostat operation.

.2 Element response.

.3 Fan operation.

.4 Disconnect.

.5 Other unit control features/devices.

.2 Functional performance outline:

.1 Interlocks with associated equipment.

.2 Interface with adjacent building components.

3.4 Protection

3.4.1 Protect from damage during construction.

3.4.2 Do not operate during construction or until unit and area thoroughly cleaned and inspected.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install split system heat pump air conditioning units with associated controls and appurtenances.

1.2 Related Sections

1.2.1 Section 15010 - Mechanical General Requirements

1.2.2 Section 15100 - Basic Materials and Methods

1.2.3 Section 15184 - Refrigerant Piping

1.2.4 Section 15260 - Thermal Insulation for Piping

1.3 Reference Standards

1.3.1 CSA (Canadian Standards Association)

1.3.2 UL (Underwriters Laboratories Inc.)

1.4 Submittals

1.4.1 Submit in accordance with Division 1.

1.4.2 Submit in accordance with Section 15010 - Mechanical General Requirements

1.5 Shop Drawings

1.5.1 Submit shop drawings indicating:

.1 Product Data: Provide manufacturers literature and data indicating refrigerant connection requirements, electrical characteristics and drainage.

.2 Installation Data: Manufacturer's special installation requirements including procedures required for rigging and making service connections.

.3 Manufacturer's Field Reports: Indicate conditions at initial start-up including date, and initial set points.

1.6 Closeout Submittals

1.6.1 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6.2 Warranty Documentation: The contractor shall provide a written warranty providing all labour and parts for a minimum of one year after substantial completion.

1.7 Quality

1.7.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years' experience.

1.8 Regulatory Requirements

1.8.1 Products Requiring Electrical Connection: Listed and classified by UL and CSA.

1.9 Warranty

1.9.1 Provide a one (1) year on all parts and labour.

1.9.2 Provide a five (5) year warranty to include coverage for refrigeration compressor.

2 PRODUCTS

2.1 Manufacturers

2.1.1 Acceptable manufacturers:

.1 Mitsubishi.

.2 Daikin.

.3 LG.

.4 Or Agency Approved Equal.

2.2 Air Conditioning Units

2.2.1 General:

.1 Indoor Unit: Packaged, air cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, evaporator fans and motors, refrigerant coils, discharge grilles, permanent removable filters, built-in condensate lift mechanism, fresh air intake opening, controls and refrigerant.

.2 Outdoor Unit: Packaged, self-contained, factory assembled pre-wired and pre-piped unit consisting of cabinet, compressor, outdoor refrigerant coil and fan, service valves, check valves, reversing valves, filter strainer, gauge ports, relays, contactors, circuit breakers, and starters.

.3 Indoor unit and outdoor unit shall be of same manufacturer and shall be matched for performance.

2.3 Refrigerant Compressors

2.3.1 Compressor shall be high performance rotary type.

2.3.2 Units must be equipped with high-pressure cut-off with manual reset.

2.3.3 Mounted enclosed panel shall include:

.1 Suction and discharge refrigerant pressure gauge tapping's.

.2 High and low pressure cut out.

.3 Low ambient kit for operation to -40°C

.4 Time delays to prevent repeated cycling of compressor on low loads, crank case heater.

2.4 Outdoor Condensing Unit

2.4.1 Weatherproof outdoor unit with compressors for horizontal air flow, factory prewired and pre-piped, baked enamel finish.

2.4.2 Snow/wind guard and dip switch.

2.4.3 Single circuited coils with mechanical expanded copper tubing into aluminum fin. Clean, dehydrate and test coils. Seal and ship with holding charge of refrigerant.

2.4.4 Fan section with direct drive propeller fan. drip-proof motors, resiliently mounted, pre-lubricated with built-in overload protection. Fan and coil guards.

2.4.5 Factory provided support system for wall mounting.

2.5 Refrigerant Piping and Accessories

2.5.1 Refrigerant grade angle, globe and ball shut-off valves.

2.5.2 Pressure gauge taps at compressor inlet and outlet and at all other locations required.

2.5.3 Copper Tubing: ASTM B280, Type ACR hard drawn:

.1 Fittings: ASME B16.22 wrought copper.

.2 Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 640 to 805°C.

2.5.4 Copper Tubing to 22mm (7/8”) OD: ASTM B88, Type K, annealed:

.1 Fittings: ASME B16.26 cast copper.

.2 Joints: Flared.

2.5.5 Pipe Supports and Anchors: Conform to ASME B31.5:

.1 Hangers for Pipe Sizes 13mm to 38 mm (1/2” to 1-1/2”): Carbon steel adjustable swivel, split ring.

.2 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.3 Vertical Support: Steel riser clamp.

.4 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.5 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.5.6 Refrigerant grade angle, globe and ball shut-off valves.

2.5.7 Pressure gauge taps at compressor inlet and outlet and at all other locations required.

2.6 Controls

2.6.1 Provide programmable, solid state electronic, microprocessor controls as specified and required, including relays and control devices.

2.6.2 Provide control devices to maintain proper compressor head pressures. Interlock condenser operation to refrigeration cycle and to switch reversing valves, etc.

2.6.3 Refer to contract drawings for remote controllers.

3 EXECUTION

3.1 Examination

3.1.1 Verification of existing conditions prior to beginning work.

3.1.2 Verify that electric power is available and of the correct characteristics.

3.2 Installation

3.2.1 Install to manufacturer's written instructions.

3.2.2 Coordinate installation of air conditioning unit with Division16, Electrical.

3.2.3 Provide adequate drainage connections for condensate. A factory installed integral pump shall be provided for the evaporator condensate.

3.2.4 The refrigeration contractor shall install and terminate interlock wiring between the air conditioning units and the associated remote condensing units on the roof.

3.2.5 Provide a condensate drain trap with a pump at each unit. The inlet leg of the traps should be a minimum of 25mm (1”) higher than the outlet leg. Condensate drain piping should be graded towards the plumbing drain at minimum 1:200.

3.3 Manufacturers Field Services

3.3.1 Install units as indicated and to manufacturers' recommendations.

3.3.2 Provide and install all necessary refrigerant piping and electrical connection between "split" units.

3.4 Performance

3.4.1 Refer to equipment schedules on Mechanical drawings.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide and install ductwork, fittings and all accessories as required.

1.2 Reference Standards

1.2.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

.1 SMACNA HVAC Duct Construction Standards

.2 ASHRAE Standards

.3 AMCA Standards

.4 ULC

.5 ANSI

.6 NFPA Standards

1.3 Related Sections

1.3.1 Section 15010 - Mechanical General Requirements

1.3.2 Section 15100 - Basic Materials and Methods

1.3.3 Section 15900 – HVAC Controls

1.3.4 Division 16 - Electrical

1.4 Submittals

1.4.1 Submit shop drawings in accordance with Section 15010 – Mechanical General Requirements.

2 PRODUCTS

2.1 Noise and Vibration Control

2.1.1 All Ductwork: to be constructed to withstand 1-½ times working static pressure and designed for 500 Pa (2") operating pressure minimum.

2.1.2 All ducting on fan suction shall be rated to withstand negative pressure of 1-½ fan pressure static, dead head rating.

2.1.3 Ductwork: Use the type of isolators on equipment to obtain optimum results, consult with the isolator manufacturer to provide installation instructions for each product.

2.2 Ductwork

2.2.1 All Ductwork: to be constructed to withstand 1-½ times working static pressure and designed for 500 Pa (2") operating pressure minimum.

2.2.2 Ducts: lock forming quality steel with minimum G90 designation zinc coating to A526/A526M-85. Gauge of ducts shall be in accordance with recommendations of ASHRAE and SMACNA.

2.2.3 Fabrication: ducts and fittings configuration in accordance with recommendations of SMACNA and ASHRAE.

2.2.4 Joints:

.1 to SMACNA and ASHRAE.

.2 May be made with the Ductmate System. System components shall be made of standard catalogue manufacture as supplied by Ductmate Industries, Inc.

2.3 Sheet Metal Ductwork

2.3.1 Provide sheet metal ductwork and accessories for supply and exhaust ductwork serving the unclassified areas.

2.3.2 Ductwork Systems - Reference Standards:

.1 Provide ducts, fittings, accessories and supports conforming to the construction details as described in the latest editions of the following publications, except as modified hereinafter:

.1 Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - "HVAC Duct Construction Standards - Metal and Flexible"

.2 SMACNA - "Guidelines for Welding Sheet Metal"

.3 SMACNA - "Testing Balancing and Adjusting of Environmental Systems"

.4 NFPA - "Standard for Installation of Air Conditioning and Ventilation Systems" - NFPA 90A

.2 Provide a minimum SMACNA Class 'C' seal for all ductwork.

.3 Install sheet metal deflector vanes the full height of duct in square elbows and in elbows where radius is less than 1.5 times width of duct, security riveted in place. Provide double thickness vanes of the same gauge as the duct in which they are installed.

.4 All exterior ductwork to be stainless steel to match existing.

.5 Maintain all ductwork free of dust and debris during construction. Clean interior of ductwork prior to operating any equipment.

.6 Reinforce ductwork at all penetrations for thermometers, manometers, thermostats, gauges, etc. and provide extended collars for instruments installed in insulated ductwork.

.7 Provide rubber grommets where copper tubing passes through ductwork or casings.

.8 Where obstructions pass through ducts, provide tear-drop shaped deflectors around obstructions to avoid air flow interference. Increase ductwork size around deflectors to maintain equivalent free area. Caulk holes up in ductwork and provide cover-plates to close spaces left between duct and obstruction.

.9 Make all necessary provisions and allowances when installing ductwork for the structural building framing and transform or divide ducts as required. Maintain free area.

.10 Protect open ends of ducts during installation with suitable closures to preclude dirt and debris from entering.

.11 Ductwork leakage shall be less than 5% of fan air flow capacity.

2.3.3 Rectangular Ductwork:

.1 Fabricate ductwork of the following minimum thickeners with joints and bracing:

Nominal Thickness Millimetres	Millimetres	Type of Transverse Joint Connections	Bracing
0.55	0-300	S Cleat or Drive Cleat on 2440mm centres	None
0.70	330-450	S Cleat or Drive Cleat on 2440mm centres	None
0.85	790-1070 1100-1370	25mm T Cleat or 25mm Angle S Cleat on 910mm staggered centres 38mm T Cleat or 38mm Angle S Cleat on 910mm staggered centres	None 38 x 38 x 3mm intermediate side angles of 1220mm from joint
1.00	1400-2140	Reinforced Angle Cleats bolted to the duct at 610mm intervals	38 x 38 x 3mm intermediate side angles of 610mm from joint
1.31	2160mm and over	38mm reinforced Angle A Cleat 38mm reinforced S-T Cleats 50 x 50 x 5mm Angle flanges on 910mm staggered centres	38 x 38 x 3mm intermediate side angles of 38 x 38 x 3mm angle joint, 610mm from joint

.2 Cross-break all flat un-installed sheet metal ductwork having any side are 300mm, except immediately upstream and downstream of splitter dampers.

.3 Provide longitudinal duct seams as follows:

.1 Corners

.1 Pittsburgh or double corner seams

.2 Mid-section

.1 Grooved seam or inside standing seam up to 500 Pa

.4 Construct tees, bends or elbows with a centreline radius of not less than 1.5 times the width of the duct. Where space does not permit the specified radius, use square throat fitting with double thickeners turning vanes.

2.4 Hangers and Supports

2.4.1 Fabricate strap hangers to same material as duct. Hanger configuration to SMACNA details. 500 mm (20") is maximum duct size to be supported by strap hanger.

2.4.2 Rod and angle hangers: galvanized steel to SMACNA details.

2.4.3 Hanger attachments: manufactured concrete inserts, expansion shields and bolted steel clamps. Do not weld rods to steel decks or use powder actuated fasteners.

2.5 Duct Sealant

2.5.1 General: water-based sealant, non-toxic, non-combustible, non-flammable, and tested in accordance with CAN4-S102. Flame spread shall not exceed 25 and smoke developed shall not exceed 50.

2.5.2 Acceptable Product: Multi-Purpose Duct Sealant as manufactured by Trans Continental Equipment, Duro Dyne SWB Duct Sealer, Iron Grip 601 as supplied by Alpha Sheet Metal Co., Uni-Grip Duct Sealer from United McGill Corporation or Agency Approved Equal.

2.6 Flexible Connections

2.6.1 Outdoors: 814 g/m^2 (24 oz per sq. yd.) tensile strength of not less than 450 x 400 lbs (2000x1780 N) with metal to 75 mm (3") fabric to metal "Grip-Lok" duct connections. Durolon indicated. Dyn-Air.

2.6.2 Indoors: 750 g/m^2 (22 oz. per sq. yd.) tensile strength of not less than 290 x 290 lbs (1290x1290 N) with metal to 75 mm (3") fabric to metal "Grip-Lok" duct connections. Canflex indicated. Dyn-Air.

2.7 Volume Dampers

2.7.1 Single Leaf Dampers: fabricated from minimum 1.0 mm (20 gauge) galvanized steel, suitably reinforced to prevent vibration and fitted with indicating regulator. Duro-Dyne, Lawson & Taylor, Dyn-Air.

2.7.2 Multi-Blade Opposed Action Dampers: fabricated from 1.6 mm (16 gauge) galvanized steel, mounted in separate channel frames, reinforced to prevent vibration, and fitted with opposed action linkage hardware. Duro-Dyne "Opax" blade kit, Lawson & Taylor, Dyn-Air.

2.8 Balancing Dampers

2.8.1 Provide balancing dampers in branch duct locations as indicated on the drawings. Balancing damper are to be compatible with the respective duct type

2.8.2 Provide adjustable locking mechanisms to hold the damper in a fixed position after balancing is completed.

2.9 Motorized Dampers

2.9.1 Refer to HVAC control section 15900.

2.10 Outside Air Louvres

2.10.1 Stormproof Louvres:

.1 Fixed exterior architectural aluminum louvre. Aerodynamic performance in accordance with ANSI/AMCA 500-L Certified Ratings Seal, minimum 38.5% free area. Maximum pressure drop through louvre 50Pa (0.20” W.C.). Overall size as indicated on Contract Drawings.

2.10.2 Acceptable Manufacturers: Greenheck, Nailor, EH Price or Agency Aproved Equal.

2.11 Test Ports

2.11.1 General: provide test ports to suit intended application, (ie. insulated/uninsulated duct, round/rectangular duct).

2.11.2 Acceptable Product: Air Power Co. Dial 1000, Dial 2000 or Duro-Dyne IP-1, IP-2, IPG-3, IP-4, Dyn-Air.

3 EXECUTION

3.1 Ductwork - Installation

3.1.1 Install ductwork parallel to building lines and in accordance with SMACNA standards.

3.1.2 Do not break continuity of insulation vapour barrier by hangers or rods.

3.1.3 Ground across flexible connector with No. 2/0 braided copper strap.

3.1.4 Anchor all risers as indicated.

3.1.5 Install fire dampers to NFPA90A-1985.

3.1.6 Make fresh air intake ducts watertight up to end of transition. Fit drain connection on bottom with 20mm (3/4") pipe to drain.

3.1.7 Support all ductwork from structural members. Where structural bearings do not exist, suspend strapping or hangers from steel channels or angles. Provide supplementary structural members. Do not suspend from metal deck.

3.1.8 Hangers shall be steel angles with supporting rods, locking nuts and washers to following table:

Duct Sizes	Angle Size	Rod Size	Spacing
up to 30"	1" x 1" x 1/8"	1/4"	10 feet
31" to 42"	1-1/2"x1-1/2"x1/8"	1/4"	10 feet
43" to 60"	1-1/2"x1-1/2"x1/8"	3/8"	10 feet
61" to 84"	2" x 2" x 1/8"	3/8"	8 feet
Up to 750mm	25 x 25 x 3mm	6mm	3 metres
775 to 1050mm	40 x 40 x 3mm	6mm	3 metres
1075 to 1500mm	40 x 40 x 3mm	10mm	3 metres
1525 to 2100mm	50 x 50 x 3mm	10mm	2.5 metres

3.1.9 Seal all joints and penetrations in ductwork.

3.1.10 Paint all visible internal portions of duct outlets to grilles dull black. Internal painting of ductwork behind grilles shall be by Sheet Metal Contractor.

3.1.11 Install flexible ductwork only where specifically indicated on drawing.

3.1.12 Seal and protect all openings to ductwork, existing and new, within the construction areas to ensure that no dirt or contaminants enter the ductwork. On completion of the work inspect ductwork and remove any dirt or contaminants resulting from the work.

3.2 Duct Sealing

3.2.1 Ductwork and plenums shall be sealed as follows in accordance with seal classifications A, B and C described in SMACNA and ASHRAE literature.

	DUCT LOCATION			
DUCT DESCRIPTION	SUPPLY		RETURN	EXHAUST
	<2"wc	> 2"wc		
Outdoors and Unconditioned Spaces	A	A	C	A
Conditioned Spaces	C	B	B	C

3.3 Duct Cleaning

3.3.1 All ductwork shall be thoroughly vacuumed on completion of all construction work which generates or disturbs dust and other particulate matter. Ductwork shall be cleaned immediately prior to occupancy in accordance with CAN/CSA-Z317.2.

3.3.2 The duct cleaning shall be performed by an established firm currently engaged in such work and approved by the Consultant for this project.

3.3.3 Provide duct access doors where required in the ductwork to facilitate cleaning.

3.4 Flexible Connections

3.4.1 Provide flexible duct connections between ductwork and all air handling equipment.

3.5 Volume Dampers

3.5.1 Provide volume dampers in all supply, return and exhaust duct mains at the junctions of branch ducts, and where required to properly balance system.

3.5.2 Provide single leaf dampers in branch ducts less than 300mm (12") in height where indicated, or where branch duct connection to main is made with a Tee connection.

3.5.3 Provide multi-blade opposed action dampers in branch ducts 300mm (12") or greater in height and where specifically indicated on drawings.

3.5.4 Provide additional volume dampers where required by Air Balancing agency for effective balancing of system.

3.6 Motorized Dampers

3.6.1 Install dampers supplied under Section 15900 in ducts or plenum as indicated.

3.7 Outside Air Louvres

3.7.1 Coordinate framing and anchorage for louvres with other parts of the Work.

3.7.2 Install bird screen to inside face of louvres.

3.7.3 Install louvres in accordance with manufacturer's instructions and reviewed Shop Drawings. Securely anchor into opening.

3.7.4 Install duct collars as required and extended sills as indicated.

3.8 Test Ports

3.8.1 Provide test ports as required by Balancing Agency to completely test and balance the system. No temporary holes will be permitted in ductwork or flexible connections.

3.9 Duct Leakage Tests

3.9.1 Ductwork shall be leak tested in accordance with the SMACNA AHVAC Air Duct Leakage Test Manual@. The maximum permitted duct leakage shall be:

Duct Pressure More Than	Less than or equal to	Rectangular Cfm/100ft^2 duct surface area	Round/Flat Oval Cfm/100ft^2 duct surface area
-2"wc	0"wc	-9.4	-4.7
0"wc	2"wc	9.4	4.7
2"wc	3"wc	12.3	6.1
3"wc	4"wc	14.8	7.4
4"wc	6"wc	9.6	19.2
6"wc	8"wc	11.6	23.2

3.9.2 Ductwork that exceeds the maximum permitted leakage shall be re-sealed and re-tested.

3.9.3 Duct leakage test shall be witnessed and certified by the Systems Verification Agency of section 15020.

3.9.4 Record and submit three (3) copies of test results to the Consultant for review prior to application of duct insulation or concealment of ductwork.

3.10 Adjusting and Balancing

3.10.1 Refer to Section 15020 – System Verification (Testing, Adjusting and Balancing (TAB)).

3.10.2 Do not begin air balance until system has been completed and is in full working order. Put all heating, ventilating, and air conditioning system and equipment into full operation and continue the operation of same during each working day of balancing procedures.

3.10.3 Air handling systems which include air filters shall be balanced to provide design airflows with air filters loaded so that the air pressure drop through each filter is equal to the average of the manufacturers listed initial resistance and recommended final (change-out) resistance.

3.10.4 Test and adjust each blower rpm to design requirements.

3.10.5 Test and record motor full load amperes.

3.10.6 Make Pitot tube traverse of main supply and obtain design air quantities at fans.

3.10.7 Test and record system static pressures, suction and discharge.

3.10.8 Test and adjust system for design air quantities of recirculated air.

3.10.9 Test and adjust system for design air quantities of outside air.

3.10.10 Test and record entering air temperatures (db heating and cooling).

3.10.11 Test and record entering air temperature (wb cooling).

3.10.12 Test and record leaving air temperatures (db heating and cooling).

3.10.13 Test and record leaving air temperature (wb cooling).

3.10.14 Adjust all main supply and return air ducts to proper design air quantities.

3.10.15 Adjust all zones to proper design air quantities, supply and return.

3.10.16 Test and adjust each diffuser, grille, and register to within 5% of design requirements.

3.10.17 Identify each diffuser, grille, and register as to location and area.

3.10.18 Identify and list size, type, and manufacturer of diffusers, grilles, registers, and all testing equipment. Use manufacturer's rating on all equipment to make required calculations.

3.10.19 In readings and tests of diffusers, grilles, and registers, include required velocities and tested velocities, and required air quantities and tested air quantities after adjustments.

3.10.20 In cooperation with the control manufacturer's representative, set adjustment of automatically operated dampers to operate as specified, indicated, and/or noted.

3.10.21 Adjust all diffusers, grilles, and registers to minimize drafts in all areas.

3.10.22 Adjust and set to proper order, all smoke control systems prior to testing under Section 15020. Make any adjustments requested by Section 15020.

3.10.23 Tabulate and certify test results on suitable forms and submit to Consultant and Systems Verification Agency for approval and record.

3.10.24 As part of this Contract, this Division shall make any changes in the pulleys, belts, and dampers, or add any dampers, as required for correct balance as recommended by the Systems Verification Agency, at no additional cost to the Owner.

3.10.25 After completion of tests and submittal of balancing reports, this Contractor shall provide, if requested to, a spot check of the systems with the Systems Verification Agency. If actual air quantities do not agree with the test reports, this Agency shall rebalance the system to the satisfaction of the System Verification Agency.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Design, Labour, Products, equipment and services necessary for commercial fan Work in accordance with the Contract Documents.

1.2 Related Sections

1.2.1 Section 15010 - Mechanical General Requirements

1.2.2 Section 15100 - Basic Materials and Methods

1.2.3 Section 15900 – HVAC Controls

1.2.4 Division 16 - Electrical

1.3 Reference Standards

1.3.1 AMCA Publications 99, Standards Handbook.

1.3.2 ANSI/AMCA Standard 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.3.3 AMCA Standard 220, Laboratory Methods of Testing Air Curtains for Aerodynamic Performance Ratings.

1.3.4 AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.

1.3.5 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.3.6 ANSI/ASHRAE 51, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.3.7 BS-848, Fans for General Purposes. Performance Testing Using Standardized Airways.

1.3.8 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

1.3.9 ISO-5801, Industrial Fans - Performance Testing Using Standardized Airways.

1.4 Design/Performance Requirements

1.4.1 Industrial grade equipment design and performance, unless noted otherwise.

1.4.2 Capacity:

.1 Flow rate, external static pressure, brake power, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

1.4.3 Balancing:

.1 Statically and dynamically balanced to 2 mm/s peak or less, except where noted otherwise.

1.4.4 Sound ratings:

.1 To ANSI/AMCA (Air Moving and Conditioning Association) Standard 301, tested to AMCA Standard 300. Bear AMCA certified sound rating seal.

1.4.5 Design/Performance ratings:

.1 **Fans:** Based on tests performed to ANSI/AMCA Standard 210 and ANSI/ASHRAE 51. Bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.5 Submittals

1.5.1 Submit in accordance with Division 1.

1.5.2 Submit in accordance with Section 15010 - Mechanical General Requirements.

1.5.3 Shop Drawings:

.1 Submit shop drawings indicating:

.1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and troubleshooting protocol.

.2 Elevations, sections, details and operating components, dimensions, gauges, finishes and relationship of operating components to adjacent construction.

.3 Complete electrical wiring diagrams including electrical schematics and sequence of operation.

.4 Provide fan curves and sound rating data, showing point of operation, brake power and efficiency.

1.5.4 Quality Assurance

.1 Submit design data and test reports related to factory noise and vibration measurements.

.2 Submit manufacturer’s field reports.

1.5.5 Closeout Submittals

.1 In accordance with Division 1:

.1 Submit Test Procedures.

.2 Submit Certificate of Readiness.

.3 Submit Test Reports.

.4 Submit Closeout Report.

1.5.6 Quality

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years' experience.

1.5.7 Commissioning

.1 Submit design data and test reports related to factory noise and vibration measurements.

.2 Submit manufacturer's field reports

1.5.8 Closeout

.1 Submit the following for incorporation into Operation and Maintenance Manuals in accordance with Division 1:

.1 Identification: Manufacturing name, type, year, serial number, number of units, capacity and identification of related systems.

.2 Functional description detailing operation and control of components.

.3 Performance criteria and maintenance data.

.4 Operating instructions and precautions.

.5 Safety precautions.

.6 Lubrication schedule indicating lubrication points and type of lubricant recommended.

.7 Maintenance and troubleshooting guidelines/protocol and recommended equipment for analysis and repair.

.8 Delivery and storage instructions for each type of fan.

.9 Copy of full set of reviewed Shop Drawings and, if applicable, Marked-up Shop Drawings.

.10 Warranty information.

1.6 Training

1.6.1 Provide training plan, training course material, training schedule, and training in accordance with Division 1.

1.7 Delivery Storage, and Handling

1.7.1 Reject equipment delivered to site in damaged condition.

1.7.2 Store in manufacturer's unopened packaging in clean, dry area prior to installation.

1.7.3 Unpack and handle in accordance with manufacturer's instructions.

1.8 Extended Warranty

1.8.1 Provide warranty for Air curtains in accordance with General Conditions, except warranty period is extended to 5 years against defects in workmanship and materials for all components.

1.8.2 Provide warranty for Airfoil ceiling fans in accordance with General Conditions, except warranty period is extended to 3 years against defects in workmanship and materials for motor and controller, lifetime for airfoil and hub.

2 PRODUCTS

2.1 General

2.1.1 Products shall comply with applicable referenced standards.

2.1.2 Powered equipment shall meet the requirements of Division 16.

2.1.3 Fan operating flow rates shall be within 5% of schedule.

2.1.4 Fans shall be UL/cUL listed

2.1.5 Constructed to AMCA Publications 99.

2.1.6 Arrangement and Class: As indicated on schedule.

2.1.7 Vibration Isolation: As recommended by fan supplier for indicated installation arrangement

2.1.8 Final Selection: Fan supplier to make final selection of equipment based upon performance based "selection criteria" indicated in schedule and herein.

2.2 Direct Drive In-line Fans

2.2.1 Provide direct drive centrifugal inline fans. Refer to the contract drawings.

2.2.2 Certifications:

.1 AMCA Sound and Air.

.2 High wind and hurricane seismic.

.3 UL/cUL 765

2.2.3 Construction:

.1 Aluminum housing.

.2 Aluminum wheel material.

.3 Backward incline wheel.

.4 Two bolted access panel.

.5 Integral duct connection flanges.

.6 Spark B construction.

.7 Isolators and brackets, neoprene hanging 1 kit of 4.

.8 Internal lifting lugs.

2.2.4 Motor:

.1 Motor with thermal overload.

.2 Motor with CSA approval.

.3 Motor shall be explosion proof rated for classified areas.

.4 Ball bearings motors.

2.2.5 Finish:

.1 Coated with Permatector.

2.2.6 Bearings:

.1 Aluminum bearing cover.

2.2.7 Fasteners:

.1 Corrosion resistant fasteners.

2.2.8 Accessories:

.1 Switch, NEAM 7 and 9, toggle, shipped with unit, Division 1 wiring.

.2 Junction box mounted and wired.

.3 Inlet adapter, square to round.

.4 Outlet adapter, square to round.

.5 Performance Baffle: 110mm dia.

.6 Aluminum Rub Ring.

2.2.9 Acceptable manufacturers:

.1 Penn/Barry

.2 Greenheck.

.3 Cook

.4 Twin City

.5 Or Agency Approved Equal

3 EXECUTION

3.1 Preparation

3.1.1 Provide reviewed Shop Drawings, including dimensions of vibration isolation frames, to trades responsible for constructing supports on roof. Clearly indicate required support dimensions.

3.2 Fan installation – General

3.2.1 Install fans in accordance with manufacturer's installation instructions, good engineering practice and as indicated.

3.2.2 Locate exhaust fan discharge at least 3 m away from building openings and fresh air intakes.

3.2.3 Coordinate wiring and lockable disconnect with Division 16.

3.3 Commissioning

3.3.1 Perform Commissioning in accordance with Division 1 and Division 15.

3.3.2 Verify operational performance in general conformance with following outlines:

.1 Measurements: Airflow, static pressure, voltage and amp draw.

.2 Noise and vibration within acceptable limits.

.3 Ceiling fans:

.1 Required air velocity at floor level.

.2 Clearance to structure and services.

3.4 Maintenance

3.4.1 Maintain all equipment and systems installed until Substantial Performance.

3.4.2 Carry out regular scheduled maintenance of equipment and systems following Substantial Performance until Contract Completion.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide a dedicated HVAC digital control system to manage the operation of the following systems:

.1 Pump Room HVAC system.

.2 Chemical Room HVAC system.

1.1.2 Provide and install low voltage electrical wiring for components furnished under this section. This includes wiring between control components and wiring from such components to electrical control circuits of related HVAC equipment.

1.2 Related Sections

1.2.1 15010 Mechanical General Requirements

1.2.2 16010 Electrical General Requirements

1.3 Intent

1.3.1 This section describes the requirements for the HVAC control systems.

1.4 General

1.4.1 Furnish all labour, materials, tools and equipment required to implement a ventilation control system to suit the description of operation described herein and shown on the drawings.

1.5 Hazardous/Classified Areas

1.5.1 This project contains areas likely to contain explosive gasses at times.

1.5.2 Provide equipment and perform work to suit classified/hazardous areas as indicated on the drawings.

1.5.3 All equipment installed in hazardous locations shall be non-sparking and all electrical equipment shall be rated to suit.

1.6 Coordination

1.6.1 Electrical interlock wiring of field devices (ie: flow switches, thermostats, remote generator components) associated with equipment specified under other sections of this Division is the responsibility of the Contractor installing that equipment, unless indicated otherwise.

1.6.2 Coordinate with equipment supplied under Division 16, including motor starters to suit integration with the ventilation control system.

1.6.3 Coordinate controls work with the installation of the ventilation system.

1.6.4 Electrical raceways are to be supplied and installed in accordance with Division 16. Provide electrical installations in accordance with the area classification identified on the drawings.

1.6.5 Certain items of equipment supplied under Division 15900 are installed by Contractors performing work under other sections of this Division.

1.7 Quality Assurance

1.7.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.

1.8 Submittals

1.8.1 Make submittals in accordance with Division 1.

1.8.2 With bid.

1.8.3 Shop drawings.

1.8.4 As-builts.

1.9 Operations & Maintenance Manual

1.10 Training

1.10.1 Provide training in accordance with Division 1.

1.10.2 Upon completion of the work, the Owner's operating and maintenance personnel shall be given complete instructions on the operation and maintenance of the system.

1.10.3 An owner's manual prepared for this project by the facilities management contractor shall be used in conjunction with the training. Two (2) copies of the owner's manual shall be provided.

1.10.4 Operator instruction shall take place during normal working hours.

1.10.5 The control contractor shall give four (4) hours of instruction to the Owner's designated personnel on the operation of all control equipment and describe its intended use with respect to the programmed functions specified.

1.11 Site Conditions

1.11.1 Environmental (temp range, altitude, contaminants, classified areas)

2 PRODUCTS

2.1 Control Sequence

2.1.1 Pump Room Heating and Cooling and Ventilation

.1 The Pump room HVAC system consists of motorized dampers MD-01 and MD-02, supply fan FAN-01 , split AC units ACU-01-1&2, ACU-02-1&2 , unit heaters UH-1 TO 3 and duct heater EDH-01

.2 The Pump Room ventilation system is designed for single-speed operation.

.3 Room Heating Control:

.1 An alarm will be sent to the SCADA system when the room air temperature falls below 5°C.

.2 Monitor the zone temperature. temperature setpoint shall be 15 °C for heating. Below the setpoint, UH-1 to 3 shall operate to maintain the heating setpoint.

.3 When the intake air temperature is below 15 °C, and supply fan FAN-01 is on, duct heater EDH-01 shall power on to keep the room temperature at 16 °C

.4 The system will operate be interlocked with the thermostat.

.4 Room Cooling Control:

.1 An alarm will be sent to the SCADA system when the room air temperature exceeds 27°C, the system shall alarm locally.

.2 Monitor the zone temperature. Initial temperature set point shall be 17 °C and the secondary set point shall be 25 °C for cooling.

.3 Above the initial set point, motorized dampers MD-01 and MD-02 shall open and Supply fan FAN-01 shall power on.

.4 Above the secondary set point FAN-01 will be turned off, motorized dampers MD-01 and MD-02 shall close and AC units ACU-01-1&2, ACU-02-1&2 shall power on to maintain the secondary set point.

.5 Room Ventilation Control:

.1 Supply fan FAN-01 shall be interlocked with the pump room light switch and MD-01 and MD-02 such that it will operate when the room is occupied, and dampers MD-01 and MD-02 shall open when the exhaust fan powers on.

.2 Supply fan FAN-01 shall be interlocked with timer and MD-01 and MD-02 such that it will run for 20 minutes at noon, during which time MD-01 and MD-02 will open to allow 1 full air change for the room each day.

2.1.2 Chemical Room HVAC system

.1 The Chemical room HVAC system consists of motorized dampers MD-03 and MD-04, exhaust fan FAN-02 , unit heater UH-4 .

.2 The ChemicalRoom ventilation system is designed for single-speed operation.

.3 Room Heating Control:

.1 An alarm will be sent to the SCADA system when the room air temperature falls below 5°C.

.2 Monitor the zone temperature. temperature setpoint shall be 10 °C for heating. Below the setpoint, UH-4shall operate to maintain the heating setpoint.

.3 The system will operate be interlocked with the thermostat.

.4 Room Ventilation Control:

.1 The exhaust fan FAN-02 shall operate continuously.

.2 An alarm will be sent to the SCADA system when FAN-02 shuts down.

.3 Exhaust fan FAN-02 shall be interlocked with MD-03 and MD-04 such that dampers MD-03 and MD-04 shall open when the exhaust fan powers on.

2.2 Electronic Temperature Sensors

2.2.1 Supply factory calibrated temperature sensors that utilize 1000 ohm nickel wire or platinum (RTDs).

2.2.2 Temperature sensors utilized for wall mounting with cover and metal guard.

2.2.3 Acceptable Manufacturers:

.1 Equal to Johnson Controls TE-6700 series.

2.3 Control System Components

2.3.1 Provide as required to provide complete and fully functional system.

2.3.2 Acceptable Manufacturers:

.1 Equal to Johnson Controls, Metasys GCM controller.

2.4 Motorized Dampers

2.4.1 Dampers

.1 Supply control dampers with a leakage rate of less than 3 cfm/sq. ft. at 1" static pressure.

.2 Use opposed blade type dampers for modulating service. Dampers for two position service face and bypass and mixing may be parallel blade type.

.3 Construct aluminium airfoil blades of minimum 12 gauge extruded aluminium. Blades to be 6" wide single air foil design.

.4 Construct damper frames of extruded aluminium channel with grooved inserts for vinyl seals. Standard frames are 2" x 4" x 5/8" on linkage side, and 1" x 4" x 1" on the other sides.

.5 Provide 7/8" hexagon extruded aluminium pivot rods that interlock into the blade section. Bearings to be double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.

.6 Design the bearing to prevent metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.

.7 Blade linkage hardware is to be installed in a frame out of the airstream. All hardware to be made of non-corrosive reinforced material or cadmium plated steel.

.8 Supply overlapping damper seals that minimize air leakage.

.9 Insulate all dampers in direct contact with outside air with 7/8" thick polyurethane foam with R factor of 5.0 per inch. Blade construction must provide a 100% thermal break. Include frame with polystyrene, R factor of 5.0 per inch.

.10 Maximum allowable damper blade length is 40" per section.

.11 Provide dampers greater than 2 sections wide with a jackshaft

.12 Damper frames and blades shall not be less than 12 gauge, 0.081” (2.1mm) extruded aluminium. Channel frame to be 4” (101.6mm) deep.

.13 Blades to be single unit internally reinforced and connected to frame with a 7/16” hexagon rod. Internal hollows to be insulated with 7/8” thick polyurethane foam with T factor of 5.0 per inch. Blades shall be thermally broken.

.14 Blade and frame seals to be extruded synthetic rubber secured in an integral slot within the blade extrusion.

.15 Frame shall be insulated with polystyrene, R factor of 5.0 per inch.

.16 Bearings to be comprised of Celcon inner bearing fixed onto a hexagon rod rotating within a Polycarbonate outer bearing inserted into frame, resulting in no metal to metal contact.

.17 Linkage hardware to be out of airstream and constructed of aluminium and corrosion resistant zinc plated steel, equipped with cup-point trunnion screw for slip-proof grip.

.18 Dampers shall be suitable for operating in temperatures ranging between -40°F (-40°C) and 165°F (731°C).

.19 Leakage shall not exceed 0.6% of the rated air flow at 10” WG differential static pressure across the damper.

2.4.2 Acceptable Manufacturers:

.1 T.A. MORRISON Tamco 1000 / 9000

.2 Greenheck HCD

2.5 Damper Actuators

2.5.1 Provide electric actuators of the enclosed reversible gear drive type that can accept modulating control signals as required. Actuators using balance relays or mechanical travel limiting switches are not acceptable.

2.5.2 Provide damper actuators that develop sufficient force to maintain damper rated leakage characteristics. Supply actuator with limit switch for position proving as required in sequence of operation.

2.5.3 Electric damper actuators shall be spring return.

2.5.4 Do not drive more than 25 square feet of damper with one actuator regardless of torque abilities of the actuator.

2.5.5 Where indicated to be mounted in classified areas, provide a classified housing for the actuator. Equal to Belimo ZS-260 for use in class 1 division 1 or 2 areas.

2.5.6 Damper Motors (Non-Modulating)

.1 Two (2) position spring return

.2 Operating Voltage: 120V AC

.3 Maximum Operating Torque: (133 in-lb)

.4 Adjustable Stroke: 95° of rotation (-5° to 90°)

.5 Built-in auxiliary switches (2)

.6 Timing: 30 to 60 seconds

.7 CSA approved.

.8 Acceptable Manufacturers:

.1 Belimo Model AF120-S

.2 Equivalent Honeywell product

2.6 Electrical Wiring

2.6.1 All wiring shall be in accordance with the governing electrical authority.

2.6.2 Conform with the electrical requirements of the area classifications.

2.6.3 Provide equipment, field devices, systems that are rated to suit the area classifications shown on the electrical drawings.

2.6.4 Provide all wiring in accordance with division 16 requirements.

2.6.5 Provide enclosures for all control system components.

3 EXECUTION

3.1 General

3.1.1 Install all equipment, accessories, conduit, interconnecting wiring in a neat manner by skilled and qualified work persons using the latest standard practices of the industry.

3.1.2 Unless otherwise specified, meet manufacturer's latest printed instructions for materials, planned maintenance and installation methods.

3.1.3 Notify Construction Manager in writing of any conflict between these specifications and manufacturer's instructions.

3.1.4 Retain, at no additional cost to the Owner, original equipment suppliers to provide contacts that are required on the point schedules and in the software and sequences specified. Provide the necessary relays and transformers required to interconnect equipment.

3.1.5 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of equipment.

3.1.6 Install equipment to allow for easy maintenance access. Ensure equipment does not interfere in any way with access to adjacent equipment and personal traffic in the surrounding space.

3.1.7 Install all electrical wiring in conformance with the requirements of the local electrical authority, and Provincial Building Code.

3.1.8 Install low voltage wiring in accordance with the control manufacturer's recommendations. Run all wiring in a protective conduit. Where indicated, wiring shall be suitable for classified areas. Include all conduit & sealing as required by code.

3.2 Installation

3.2.1 Install all equipment in accordance with manufacturer's published instructions.

3.2.2 Supply equipment to be installed by other divisions in accordance with their work schedule.

3.2.3 Coordinate final location of all sensors with consultant's field representative prior to installation.

3.3 Identification

3.3.1 Identify each piece of equipment with a nameplate identifying the equipment and functions with a letter and number designation.

3.3.2 Nameplates shall be minimum size 75mm x 25mm x 3mm thick (3" x 1" and 1/8" thick) laminated plastic with black face and white centre and 6.25mm (1/4”) high engraved lettering. Nameplate shall be securely attached to the equipment.

3.3.3 Printed name tags are acceptable for cabinet mounted components providing they are securely attached.

3.4 Site Acceptance Testing

3.4.1 Controls Contractor requests completion acceptance in writing and advises Owner's authorized representative of situations that prevent a complete testing of overall system performance.

3.4.2 Prior to online operation, the Owner's authorized representative gives written approval of start-up of the FMS for online operation.

3.4.3 After completion of installation and in cooperation with other involved Contractors, make adjustments to each control device and component to ensure that the operations are in accordance with the sequences of operation specified.

3.4.4 Upon completion of system start-up, the Owner's authorized representative shall be requested in writing to inspect and approve the satisfactory operation of the Control and Facilities Management System.

3.4.5 Upon receipt of a detailed system adjustment list from the Owner's authorized representative, review and implement all necessary corrections. After all items appearing on the adjustment list are completed, request approval from the Owner's authorized representative. As each or all items are approved, written confirmation shall be issued.

3.4.6 Return to the site to perform additional tests and/or adjustments, if required, to prove system performance during the warranty period.

END OF SECTION

1 GENERAL

1.1 Section Includes

1.1.1 This Section covers the Work of providing equipment, labour and materials for piping leakage testing specified herein.

1.2 Related Sections

1.2.1 Section 01010 - Summary of Work

1.2.2 Section

1.3 Standards

1.3.1 Chlorine Institute (2001 L Street N.W., Washington D.C. 28036): Pamphlet 6, Piping Systems for Dry Chlorine.

1.3.2 ASME B31.1 latest edition

1.3.3 ASME B31.3 latest edition

1.4 Submittals

1.4.1 Informational Submittals:

.1 Testing Plan: Submit prior to testing and include at least the information that follows.

.2 Testing dates.

.3 Piping systems and section(s) to be tested.

.4 Test type.

.5 Method of isolation.

.6 Calculation of maximum allowable leakage for piping section(s) to be tested.

.7 Certifications of Calibration: Testing equipment.

.8 Certified Test Report.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 Preparation

3.1.1 The Contractor shall notify the Consultant, in writing five Working Days in advance of testing and shall perform testing in the presence of the Consultant, IDI and SBI.

3.1.2 After the piping has been installed, all new pipe and valved sections shall be subjected to a leakage test.

3.1.3 The Contractor shall provide the necessary equipment and material and install taps in pipe, as required.

3.1.4 The Consultant will monitor the tests. The Contractor shall provide 24 hours advance notice of final confirmation of the start of leakage testing.

3.1.5 Pressure Piping:

.1 The Contractor shall install temporary thrust blocking or other restraints as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.

.2 The Contractor shall wait a minimum of Five Working Days after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, the wait may be reduced to two Working Days.

.3 Prior to testing, the Contractor shall remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

.4 New Piping Connected to Existing Piping:

.1 Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to the Consultant.
.2 Test joints between new piping and existing piping by methods that do not place the entire existing system under test load, as approved by the Consultant.

.5 Items that do not require testing include: Piping between wetwells and wetwell isolation valves, equipment seal drains, tank overflows to atmospheric vented drains,tank atmospheric vents.

.6 Test Pressure: As indicated on the Piping Schedule, or as specified by the equipment or piping manufacturer or as indicated on the Contract Drawings.

3.1.6 Test section may be filled with water and allowed to stand under low pressure prior to testing.

3.1.7 Gravity Piping:

.1 Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.

.2 Determine groundwater level at time of testing by exploratory holes or another method acceptable to the Consultant.

.3 Pipe 1050 mm Diameter and Larger: Joint testing device may be used to isolate and test individual joints.

3.2 Hydrostatic Test for Pressure Piping

3.2.1 Water: In accordance with Section 01500 – Construction Facilities and Temporary Controls.

3.2.2 Equipment: Provide the following:

Amount	Description
2	Graduated containers
2	Pressure gauges
1	Hydraulic force pump
	Suitable hose and suction pipe as required

3.2.3 Exposed Piping:

.1 Perform testing on installed piping prior to application of insulation.

.2 Maximum Filling Velocity: 0.076 metres per second, applied over full area of pipe.

.3 Before applying the specified test pressure, the Contractor shall expel air completely from the section of piping under test. If permanent vents are not located at all high points, the Contractor shall install corporation cocks at such points so that air can be expelled as the line is filled with water. Vent piping during filling. Open vents at high points of piping system or use equipment vents to purge air pockets.

.4 Allow the system to stabilize for at least 15 minutes before conducting the leakage test.

.5 Maintain hydrostatic test pressure continuously for 120 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.

.6 All exposed pipe, fittings, valves and hydrants shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants or joints that are discovered following the pressure test shall be repaired or replaced with new and the test shall be repeated until satisfactory results are obtained, at no extra cost to the Owner.

.7 Correct visible leakage and retest as specified in the Contract Documents.

.8 Empty pipe of water prior to final cleaning or disinfection.

3.2.4 Buried Piping:

.1 Before commencing and only after a visual inspection has been completed by the Consultant, the Contractor shall backfill the trench and prevent movement of the pipe with joints, valves and fittings exposed. Exposed joints for the acceptance test on buried pressure piping to be pneumatically tested or subjected to an initial service leak test.

.2 Conduct final hydrostatic acceptance tests after trench has been completely backfilled.

.3 Before applying the specified test pressure, the Contractor shall expel air completely from the section of piping under test. If permanent vents are not located at all high points, the Contractor shall install corporation cocks at such points so that air can be expelled as the line is filled with water. Vent piping during filling. Open vents at high points of piping system or use equipment vents to purge air pockets.

.4 Cement-Mortar Lined Piping: Slowly fill the test section with water and allow to stand for 24 hours under slight pressure to allow cement-mortar lining to absorb water.

.5 Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.

.6 Allow the system to stabilize for at least 15 minutes before conducting the leakage test.

.7 Maintain hydrostatic test pressure continuously for a minimum of 2 hours, reopening the isolation valve only as necessary to restore test pressure.

.8 Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.

.9 Accurately measure amount of water required to maintain test pressure by placing pump suction in a barrel or similar device, or by metering.

.10 Maximum Allowable Leakage:

$$L = \frac{SD(P)^{1/2}}{715{,}317}$$

where:

L	=	Allowable leakage, in Litres per hour.
S	=	Length of pipe tested, in metres.
D	=	Nominal diameter of pipe, in milimeters.
P	=	Test pressure during leakage test, in kPa.

This formula is based on a testing allowance of 1.079 L/d/km/mm of nominal diameter at a pressure of 1,034 kPa.

.11 Correct leakage greater than allowable, and retest as specified.

3.3 Pneumatic Test for Compressed Air, Natural Gas and Vacuum Piping

3.3.1 Do not perform on:

.1 PVC, PE or CPVC pipe.

.2 Piping larger than 150 mm.

.3 Buried and other non-exposed piping.

3.3.2 Fluid: Oil-free, dry air.

3.3.3 Equipment: Provide the following:

Amount	Description
1	Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105 per cent of the required primary test pressure
1	Calibrated test gauge
As required	Nitrogen for purging after testing lines that will carry flammable gases.

3.3.4 Perform tests only on exposed piping, after piping has been completely installed, including supports, hangers and anchors, and inspected for proper installation.

3.3.5 Take necessary precautions to protect test personnel and the Owners' operations contractor from hazards associated with air testing.

3.3.6 Secure piping to be tested to prevent damage to adjacent piping and equipment in the event of a joint failure.

3.3.7 Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by test.

3.3.8 Procedure:

.1 Apply preliminary pneumatic test pressure of 172 kPag maximum to piping system prior to final leak testing, to locate visible leaks.

.2 Apply soap bubble mixture to joints and connections; examine for leakage.

.3 Correct visible leaks and repeat preliminary test until visible leaks are corrected.

.4 Gradually increase pressure in system to not more than half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.

.5 Allow the system to stabilize for at least 15 minutes before conducting the leakage test.

.6 Maintain pneumatic test pressure continuously for minimum of 120 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.

.7 All exposed pipe, fittings, valves and hydrants shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants or joints that are discovered following the pressure test shall be repaired or replaced with new and the test shall be repeated until satisfactory results are obtained, at no extra cost to the Owner.

.8 Correct visible leakage and retest as specified.

1.1.1 Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

1.1.2 After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

3.4 Hydrostatic Test for Gravity Piping

3.4.1 Testing Equipment Accuracy: Plus or minus 1.9-litres of water leakage under the specified conditions.

3.4.2 Maximum Allowable Leakage: 0.078 litres per hour per millimeter diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified in the Contract Documents.

3.4.3 Gravity Sanitary and Roof Drain Piping: Test with 4.6 m of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 4.6 m in height, test systems in 4.6 m vertical sections as piping is installed.

3.4.4 Exfiltration Test:

.1 Hydrostatic Head:

.1 At least 1.8 metres above the maximum estimated groundwater level in the section being tested.
.2 No less than 1.8 metres above the inside top of the highest section of pipe in the test section, including service connections.

.2 Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 9.1 m of water column.

3.4.5 Infiltration Test:

.1 Groundwater Level: At least 1.8 metres above the inside top of the highest section of pipe in the test section, including service connections.

3.4.6 Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

3.4.7 Defective Piping Sections: Replace and retest as specified.

1.2 Pneumatic Test for Gravity Piping

3.4.8 Equipment:

.1 Calibrate gauges with standardized test gauge provided by the Contractor at start of each testing Day. The Consultant will witness calibration.

.2 Install gauges, air piping manifolds, and valves at ground surface.

.3 Provide pressure release device, such as rupture disc or pressure relief valve, to relieve pressure at 41.4 kPa or less.

.4 Restrain plugs used to close sewer lines to prevent blow off.

3.4.9 Procedure:

.1 Require that no person enter manhole where pipe is under pressure.

.2 Slowly introduce air into pipe section until internal air pressure reaches 27.6 kPa greater than average back pressure of groundwater submerging pipe.

.3 Allow 2 minutes minimum for air temperature to stabilize.

3.4.10 Allowable Leakage: Test section will be considered defective when the time required for the pressure to decrease from 24.1 kPa to 17.2 kPa greater than the average back pressure of groundwater submerging pipe is less than that computed utilizing values from following table:

TABLE 1*

A Pipe Diameter (mm)	B Time per Meter up to Length in Col C (Seconds)	C Test Length (m)	D Test Time for any Length Between Col C & E (Min:Sec)	E Length at Which Time in Col F Applies (m)	F Time per Meter for Total Length (Seconds)
100	0.59	193.9	1:54	339.5	0.33
150	1.31	129.2	2:50	226.5	0.75
200	2.33	96.9	3:47	169.8	1.34
250	3.64	77.7	4:43	135.9	2.07
300	5.25	64.5	5:40	111.3	2.98
375	8.20	51.8	7:05	89.1	4.66
450	11.90	43.0	8:30	74.4	6.75
525	16.13	36.9	9:55	63.9	9.21
600	21.05	32.3	11:20	56.1	12.03

EXAMPLE: 375 mm diameter pipe:
For 50 m, T = 8.20 sec (Col B) x 50 m = 410 sec = 6:50
For 75 m, T = 7:05 (Col D)
For 150 m, T = 4.66 sec (Col F) x 150 m = 699 sec = 11:39

*Based on 0.015 L/s/m^2 with a minimum significant loss of 0.94 L/s and a maximum loss of 1.65 L/s.

3.4.11 Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

3.4.12 Defective Piping Sections: Replace and retest as specified.

3.5 Field Quality Control

3.5.1 Test Report Documentation:

.1 Test date.

.2 Description and identification of piping tested.

.3 Test fluid.

.4 Test pressure.

.5 Remarks, including:

.1 Leaks (type, location).
.2 Repair/replacement performed to remedy excessive leakage.

.6 Certification signed by the Contractor and the Consultant and the Owner to represent that test has been satisfactorily completed.

END OF SECTION

DIVISION 16 – ELECTRICAL

Section No.	Title
16010	Electrical General Requirements
16015	Electrical System Analysis
16051	Installation of Cables in Ducts and Trenches
16061	Grounding – Primary
16062	Grounding – Secondary
16090	Equipment Identification
16111	Cable Tray Systems
16122	Wires and Cables 0-1000V
16131	Splitters, Junction, Pull Boxes & Cabinets
16132	Outlet Boxes, Conduit Boxes & Fittings
16133	Conduits, Conduit Fastenings & Fittings
16141	Wiring Devices
16222	AC Induction Motors
16223	Motor Starters to 600V
16224	Variable Frequency Drives to 600V
16225	Motor Control Centre (MCC)
16231	Diesel Electric Generating Unit
16271	Dry Type Transformers
16301	Automatic Transfer Switches
16400	Basic Electrical Equipment & Materials
16412	Moulded Case Circuit Breakers
16414	Disconnect Switches – Fused & Unfused
16441	Panelboards Breaker Type
16505	Lighting Equipment

Section No.	Title
16531	Exit Lights
16536	Emergency Lighting Units
16671	Surge Protective Devices

1 GENERAL

1.1 Description

1.1.1 This section describes the following:

.1 General and common requirements for Division 16 (Electrical Work)

.2 Overall scope of work for Division 16

.3 General coordination between Division 16 and related work in other Divisions including but not limited to Division 11, 15, and 13

1.1.2 General Utility Servicing and Utility Coordination requirements:

.1 The initial utility service entrance, and power supply to the site will be based on the installation of a utility owned 27.6kV aerial pole line, to facilitate the 600V, 3 phase service to the Blind River Low Lift Pumping Station. The service entrance utility transformer will be pole-mounted and utility owned.

.2 The initial fiber communications service shall be mounted to the new Hydro One-owned utility pole located at the new Blind River Low Lift Pumping Station and will route via existing hydro utility poles to the existing Blind River Water Treatment Plant. The Contractor shall coordinate with Hydro One for all activities related to fiber installation on Hydro One-owned utility poles. Fiber attachments to Hydro One-owned utility poles shall only be performed by a contractor approved by Hydro One. The Contractor is responsible for ensuring compliance with all Hydro One standards, guidelines, and permitting requirements prior to commencing work.

.3 The contractor shall coordinate with the owner at the existing Blind River Water Treatment Plant for exact fiber conduit entry point as well as final routing and termination of the new fiber feed inside of the building.

1.1.3 The following definitions apply:

.1 Provide - To Supply and Install, complete and in place, including accessories, finishes, tuning, configure, tests, commissioning and services as required to render item so specified complete, functional and ready for use.

.2 Remove and Dispose – to physically loosen, undo, unhinge, unbolt, cut and take an item from its location, including all fasteners, and appurtenances related to the item and discard the item and related fasteners and appurtenances at an appropriate facility, including licensed transportation disposal services, unless specifically requested to be salvaged by the Owner.

.3 Commission - Start-up and initial operation of equipment as required to demonstrate satisfactory operation of components and entire system including calibration of any control instrumentation as required to maintain operations.

.4 Drawings, Lists or Schedules of Items are intended to show scope and arrangement of work. For locations of items described refer to such Drawings, Lists or Schedules unless

locations are stipulated in the Specifications. Confirm all locations on site prior to proceeding with installation works.

1.2 Scope of Work

1.2.1 This section provides a summary of the scope of work. In addition to scope identified herein, refer to the (Electrical Safety Authority) ESA Plan Review appended to this section (Section 16010-S1) and the electrical drawings for more details and additional scope items.

1.2.2 Refer to Section 01120 – Coordination and Sequence of Work.

1.2.3 Scope of work includes installation of a new instrumentation control panel and network related communication cabinets. This scope is under Division 13, however, Division 16 is responsible for providing all field wiring for connecting new instruments as indicated on drawings.

1.2.4 The scope of work includes electrical, instrumentation, and communication in the following area:

.1 Existing Blind River Water Treatment Plant

.2 New Blind River Low Lift Pumping Station

1.2.5 Utility Outdoor Service Equipment Installation:

.1 The scope of work described herein may not reflect the complete or final requirements. The Contractor shall coordinate directly with Hydro One and obtain written confirmation regarding all equipment installation requirements, conduit routing, and any associated design or construction considerations. The Contractor shall adhere to all terms, conditions, and requirements contained in Hydro One's Offer to Connect, as well as all applicable Hydro One standards, guidelines, specifications, and detailed drawings. Any additional work, modifications, or adjustments required to meet Hydro One's specific requirements—whether identified before or during construction—shall be implemented by the Contractor at no additional cost to the Owner.

.2 Refer to the contract drawings for the scope of work between the Contractor and Hydro One Inc. Contractor is to provide a construction sequence plan for Hydro One's scope of work for review prior to construction.

.3 Contractor shall retain and schedule the services of Hydro One to supply and for the installation of the new 600V, 3 phase, 4 wire service including but not limited to the following:

.1 Provide 27.6kV primary and 600V secondary terminations to the new pole-mounted utility transformer. Note: Secondary 600V conductors and riser conduit to be provided by the contractor, confirm with Hydro One prior to installation.

.2 New utility pole and overhead line, Utility pole-mount transformer, CTs/PTs for installation in the MCC utility metering section, metering cabinets and all related equipment as indicated on the drawings.

.3 Permit joint use agreement between the contractor and Hydro One Networks Inc. for the installation of a new fiber cable from the new Blind River Low Lift Pumping Station to the existing Blind River Water Treatment Plant.

.4 Provide conduit riser and secondary wiring for termination to new pole mount transformer. Contractor to coil sufficient wire at the new utility pole for final termination to 600V secondary bushing of the new pole-mounted utility transformer.

.5 Provide underground, concrete encased duct banks from the new utility pole, bell communications handhole, and diesel generator to the North-east corner of the new Low Lift Pumping Station, as indicated on the drawings. Construct the duct bank in accordance with the details shown on the drawings.

.6 Pay for all Hydro One costs associated with the installation of the new overhead line, Hydro Utility Pole and pole-mounted transformer.

.7 Install outdoor NEMA 4X lockable P-Base metering cabinet, complete with hinged lockable door, clear Lexsan viewing window and polyphase meter base, cabinet in accordance with Hydro One Standards for service entrance metering, based on the use of remote CT/PT's installed in the MCC service entrance metering section. Provide all field wiring, raceways, and terminations to facilitate the utility metering installation.

.8 Coordinate with Hydro One to facilitate the installation of utility metering CT's and PT's in the utility metering section of the MCC.

.9 Provide a new fiber cable from the New Blind River Low Lift Pumping station to the existing Blind River Water Treatment Plant building. In coordination with the Town of Blind River, the contractor shall apply for a joint use agreement with Hydro One Networks Inc. for the supply and installation of the new fiber line. Pay for all costs associated with the installation of the new fiber services. The contractor shall submit a complete Joint Use Permit Application through Hydro One's Joint Use Management Portal (JUMP**)**. All attachments must meet Hydro One's structural, safety, and clearance requirements as outlined in their Joint Use Guide and CSA standards.

.10 Supply and install new service entrance, including but not limited to risers, weatherhead, duct bank, feeder cables from the new pole-mount transformer to the MCC and all related equipment as indicated on the contract drawings. The demarcation point shall be located at the pole-mounted weatherhead.

1.2.6 The Contractor's Scope of Work in relation to the Blind River Intake and Low Lift Pumping Station shall include but not be limited to the following:

.1 Provide the new 600V MCC-01 with new embedded ATS, starters, and VFDs complete with their respective controls and harmonic filter.

.2 Provide ICP-0001 and other electrical equipment as shown on drawings. Note: the mentioned accruements are provided under Division 13, however, Contractor is responsible for retaining the control system supplier and providing power supply & installation.

.3 Provide new Telephone termination panel as indicated in Division 13. Coordinate with local telephone provider to ensure all requirements are met prior to termination of new telephone line. Pay for all costs associated with the new service, including but not limited to: new equipment/panels, coordination, site visits (if necessary), documentation and registration fees.

.4 Provide general distribution equipment such as receptacles, wiring, junction boxes etc.

.5 Provide a new 150kW 600V outdoor diesel generator set c/w skin type sound attenuated enclosure and mounted on UL listed fuel tank.

.6 Provide protective bollards to protect the generator as noted on the drawings.

.7 Provide power to equipment supplied under other Divisions such as Division 11 and Division 15.

.8 Provide 120/208V power distribution, including lighting and general power distribution panels, transformers, and service receptacles.

.9 Provide normal, exit, and emergency lighting throughout the new building as indicated on the drawings.

.10 Provide new indoor and outdoor lighting as indicated on the drawings.

.11 Provide a complete new grounding system as noted on the drawings. The grounding system shall include the following:

.1 Buried grounding loop and electrodes installed around the building.

.2 Grounding at the pole mounted utility transformer.

.3 Buried grounding loop and electrodes installed around the building.

.4 Buried grounding loop and electrodes installed around the generator pad

.12 Supply and install new ductbanks, cable tray and cabling for 600V and 120/208V power distribution to all equipment and instruments.

.13 Supply and install new power distribution equipment (step down transformers, panelboards, control panels etc.) as indicated on the Contract Drawings.

1.2.7 Short Circuit, Protection Co-ordination and Arc Flash Study

.1 Provide a short circuit, protection coordination and arc flash hazard study. Labels are to be provided by the Vendor based on the study findings. The Vendor is responsible for coordinating and implementing the recommended settings on the protective devices and CT ratios. Studies are to be submitted in advance of all other electrical equipment/distribution Shop Drawings.

1.2.8 Provide new electrical distribution including underground conduits, electrical feeders, communication cables, junction boxes, disconnect switches etc. as required to feed new equipment.

1.2.9 Contractor shall provide grounding and bonding of all new equipment shown on the drawings.

1.2.10 Provide support to and coordinate with other disciplines as necessary.

1.2.11 Create a sequence of construction and provide for review.

1.2.12 Test and commission all new and modified equipment, power distribution and control systems.

1.2.13 Clean all electrical equipment.

1.2.14 All cable routes to be finalized by Contractor on site including those not shown on drawings.

1.2.15 Provide training as required for all equipment supplied under this Division.

1.2.16 Installation and Operation Certification

.1 Installation Certification

.1 The Contractor shall certify that the installation of the electrical work is complete and in compliance with the contract specifications and the Contract Drawings.

.2 The Installation Certification document shall include the following.

.1 Identification of the device.

.2 Confirmation that the device or component is installed in the specified location and in the correct orientation.

.3 Confirmation that all wiring installation Work related to the device (i.e. power, communication, instrumentation, control) is complete, connections are correct as per the contract drawings and manufacturer's specifications, and all connections are secure.

.4 Confirmation that the tags and labels related to the device are in place and inscriptions match the data provided in the contract Specifications and Contract Drawings.

.5 Confirmation that the device or component is clean and in good order (i.e. undamaged or if required, scratches painted).

.6 Confirmation that manuals, tools, spare parts and materials supplied with the device or component are stored in a safe location on site and accessible for retrieval.

.7 Confirmation that the feeder and branch circuit relevant to the device has been megger checked and that the check has passed.

.8 Confirmation that all installation deficiencies have been addressed.

.9 Complete the installation certification and submit the installation certification documentation to the Contract Administrator prior to commencement of the site acceptance testing (SAT). The installation certification documentation shall be submitted to support progress payment claims for this part of the project.

.2 Operation Certification

.1 The Contractor shall certify the electrical function/operation of each device and each electrically powered instrument.

.2 The Operation Certification document shall include the following.

.1 Identification of the device.

.2 Confirmation that all power phases and phase voltages are within specification.

.3 Confirmation that motor rotation is correct.

.4 Confirmation that the device or component is powered up and ready to operate.

.5 Confirmation that the device or component configuration and calibration is complete and as per specification.

.6 Confirmation that the device or component can be operated repeatedly and consistently throughout its specified operating range.

.7 Confirmation that all features and functions of the device or component operate as expected and as specified.

.8 Confirmation that all operational deficiencies have been addressed.

.3 The Contractor shall perform the operation certification for a device or component only after the device and component has successfully passed the installation certification. Perform the operation certification on the device or component as a system.

.4 Complete the operation certification and submit the operation certification documentation to the Contract Administrator prior to commencement of the site acceptance testing (SAT). The operation certification documentation shall be submitted to support progress payment claims for this part of the project.

1.2.17 Inspection & Testing:

.1 The Contractor and/or their supplier of analysis services shall:

.1 Set all protective devices

.2 Field test, inspect and verify all protective devices

1.3 General

1.3.1 Read and conform to the General Requirements (Division 1), which applies to and forms part of all sections of the work. The general instructions are intended to supplement and not to replace Division 1 requirements.

1.3.2 The specifications are divided into Divisions of work and a Division may consist of the work of more than one (1) subcontractor. The responsibility as to which subcontractor provides

labour, materials, equipment and services required to complete the work rests solely with the Contractor.

1.3.3 Electrical equipment shop drawings will not be reviewed unless they are accompanied with a copy of the electrical protection and coordination study, where the contractor performs these studies.

1.3.4 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. Install and connect all electrical and instrumentation equipment, controls and devices supplied under other sections.

1.3.5 Visually inspect the existing site conditions, including below grade areas, prior to the project award to suit the installation of the new power and controls distribution.

1.3.6 Furnish, install, test and commission a complete operational electrical system as required by the drawings and as herein specified.

1.4 Related Sections

1.4.1 Section 01120 – Coordination and Sequence of Work

1.4.2 Section 01810 – Testing and Commissioning

1.4.3 Section 16015 – Electrical System Analysis

1.4.4 Section 16400 – Basic Electrical Equipment and Materials.

1.4.5 Division 11 – Equipment

1.4.6 Division 13 – Controls, Instrumentation and SCADA

1.4.7 Division 15 – Mechanical

1.4.8 Read and conform to all Sections of the specifications. References to specific sections of the specifications do not relieve the Contractor of the requirement to read and follow all sections as a complete document.

1.4.9 The general instructions are intended to supplement and not to replace Division 1 – General Requirements. Where requirements conflict, apply the more strenuous requirement.

1.4.10 The drawings, specifications, and standards are complimentary to one another, meaning that, that which is called for on one is meant to be called for on all. Where conflict exists between the Sections, Standards and/or Drawings, obtain clarification before any material is purchased or work commences.

1.4.11 If it is not clear from the Drawings and Specifications, which Division is responsible for performing certain works, obtain clarification of the item and/or items in question.

1.5 Codes and Standards

1.5.1 All equipment and work shall meet or exceed the requirements of the Ontario Electrical Safety Code (OESC) and to all standards referenced therein.

.1 The OESC is CSA C22.1, Canadian Electrical Code, Part 1, and the Ontario Amendments to that Code.

.2 All electrical equipment shall bear all required approval marks to demonstrate approval to all applicable codes and standards.

1.5.2 Provide underground systems in accordance with CSA C22.3 No.7 except where specified otherwise.

1.5.3 Code requirements shall be considered a minimum standard. When materials shown on drawings indicated in the specifications exceed code requirements, the plans and specifications shall govern.

1.5.4 All references to regulations, codes and standards shall be made to the latest edition.

1.6 Definitions

1.6.1 The following are definitions of terms and expressions used in the specification:

.1 “Indicated” is defined as shown on the drawings or noted in contract documents.

.2 “Inspection Department/Authority” means an agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site. For this project the Inspection Authorities include:

.1 The Electrical Safety Authority (ESA)

.2 The Technical Safety and Standards Authority (TSSA)

.3 The local building inspector

.4 The local fire inspector

.3 “OESC” is defined as CSA C22.1, Canadian Electrical Code, Part 1, and the Ontario Amendments to that Code.

.4 “Provide” is defined as to supply install, verify, test and commission.

.5 “Supply Authority” is defined as the local electrical distribution company. For this project the Supply Authority is Hydro One Networks Inc.

.6 “Wiring” means wiring of power and control conductors to lighting, receptacles, as well as any controlling or controlled devices associated with them.

1.7 Coordination with Other Trades

1.7.1 The specification is divided into divisions of work and a division may consist of the work of more than one (1) subcontractor. The responsibility as to which subcontractor provides labour, materials, equipment and services required to complete the work rests solely with the Contractor.

1.7.2 The Contractor shall be responsible for all electrical wiring and terminations required for equipment supplied in other Divisions, irrespective whether or not it is shown or mentioned on the drawings and specifications respectively so as to supply a complete working system.

1.7.3 Where special wiring (cables supplied with instruments, etc.) is supplied by other Divisions, the Contractor will be responsible for the installation of this wiring in coordination with the Division supplying said wiring unless stated otherwise.

1.7.4 Where equipment is supplied by other Divisions and installed under this Division:

.1 The Contractor shall be responsible for the proper installation of all panels, enclosures, switches, fixtures, etc., as shown on the drawings.

.2 Provide all terminations, junction boxes, fittings and flex connectors, such that raceway is continuous for its intended application. The Contractor shall be responsible for coordination with other Divisions supplying equipment, as to the exact location for installation of said equipment.

.3 Raceway types are to conform with to the space classification.

.4 The Contractor shall request from other Divisions supplying equipment for installation and/or wiring under this Division, all pertinent instruction manuals, diagrams, specifications sheets, etc., required for the proper installation of the equipment.

.5 The Contractor shall be responsible for verifying that the equipment's electrical specifications are suitable for the intended application as per Division 1. Check all voltage ratings, wiring terminations, current ratings and other electrical characteristics so as to supply a complete working system.

1.8 Coordination with Authority

1.8.1 Arrange inspections of all work by the Authorities having jurisdiction over the work. On completion of the work, present to the Owner the final unconditional certificates of approval of the Inspection Authorities.

1.8.2 Pay associated fees, for all permits, inspections, and power outages to suit supply authority/utility requirements.

1.8.3 The Contractor shall provide Engineer with copies of all ESA reports, inspections, etc.

1.9 Permits, Fees and Inspection

1.9.1 The Engineer shall obtain Electrical Safety Authority (ESA) plan review prior to commencement of work. The Contractor is required to comply with all recommendations and comments provided by the ESA in the plan review report, at no additional cost.

1.9.2 Submit all necessary documentation to the ESA during the construction period including electrical distribution equipment shop drawings, short circuit protection coordination study and the arc flash hazard study. The Contractor shall abide by all comments and recommendations provided by the ESA based on the submitted information, at no additional cost.

1.9.3 Notify the Engineer of changes required by Electrical Safety Authority (ESA) prior to making changes.

1.9.4 Furnish Certificates of Acceptance from the ESA on completion of work to the Engineer.

1.9.5 Before starting any work, submit the required number of copies of drawings and specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Engineer immediately of such changes for proper processing of the requirements. Prepare and furnish any additional drawing details for information as may be required.

1.10 Contract Drawings and Specifications

1.10.1 Follow the Contract Drawings to become familiar with all conditions affecting the work, and verify spaces in which the work will be installed.

1.10.2 The drawings for electrical work are performance drawings, diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and approximate sizes and location of equipment and outlets. The drawings do not show complete architectural, process and structural details.

1.10.3 Do not scale the drawings to determine dimensions, but obtain information for accurate dimensions by referring to architectural and structural drawings, or by site measurements.

1.10.4 Review existing drawings as available at the site during the tender period. Become familiar with the condition of the existing drawings and related equipment. Allow for errors and omissions in the existing drawings and ensure that the tender price includes the provisions to make the necessary field reviews, field verifications, field changes, and drawing changes to suit the intent of the modification required.

1.10.5 Work which is indicated, but not completely detailed shall be installed by common practice or as directed by the Engineer.

1.10.6 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.).

1.10.7 Alter, at no additional cost, the location of materials and/ or equipment as directed, provided that the changes are made before installation and do not necessitate additional material.

1.10.8 Arrange work neatly and in compact fashion to maximize space available to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or material supplied by other trades as well as to accommodate unplanned future equipment. Verify spaces in which work is to be installed. Install conduit and cable runs to maintain headroom and clearances to conserve space.

1.10.9 Confirm on the site the exact location of outlets and fixtures. Confirm location of outlets for equipment supplied by other trades.

1.10.10 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

1.10.11 If discrepancies or omissions in the drawings or specifications are found, or if the intent or meaning is not clear, advise the Engineer for clarification before submitting tender.

1.10.12 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.11 Construction/Shop Drawings

1.11.1 Submit shop drawings in accordance with Section 01330 – Submittals.

1.11.2 Submit data (drawings) for review prior to commencement of manufacturing or installing with the exception of conduit, standard conduit fittings and low voltage wiring.

1.11.3 Prior to submitting the shop drawings, the Contractor shall review the shop drawings to determine that the equipment complies with the requirements of the specifications and drawings.

1.11.4 Assume responsibility for accuracy of equipment dimensions related to available space and accessibility for maintenance and service, and compliance with codes and inspection authorities.

1.11.5 Show all details of construction, dimensions, capacities, weights, and electrical performance characteristics of equipment or material.

1.11.6 Obtain manufacturer's installation directions to aid in properly executing the work. Submit two copies of such directions to the Engineer prior to installation, for use in inspecting the work.

1.11.7 Prepare composite construction drawings, fully dimensioned of cables, conduit, cable tray, sleeves, clearances, pipes, ducts, etc., and equipment in mechanical and electrical equipment rooms, ceiling spaces and all other critical locations to avoid a conflict of trades. Base drawings on manufacturer’s shop drawings. Drawings should be developed from consultation with and agreement of all trades involved.

1.11.8 Prepare drawings of equipment bases, anchors, slabs, floor and roof curbs, if needed, for the electrical work.

1.11.9 In addition to the requirements of Section 01330, provide working drawings with, but not necessarily limited to, the following additional information:

.1 Manufacturer's and Supplier's name.

.2 Manufacturer’s bulletins, leaflets and specifications of major electrical equipment.

.3 Catalogue model number.

.4 Number identifying item on the drawings and/or in the specifications such as equipment, item number, panel identification letters, etc.

.5 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.6 Where applicable, include wiring, single line and schematic diagrams.

.7 Include wiring diagrams or diagrams showing interconnections with work of other sections.

.8 Lighting fixtures, including photometric data.

1.11.10 Contractor is responsible for providing shop drawings showing the integration between supplied control panels and control panels supplied with equipment. These drawings are to be a single drawing for each specific device, showing interconnection between the device and all associated panels and terminal blocks. Engineer reserves the right to request more detailed drawings if those provided are deemed insufficient.

1.11.11 Submit samples of material and equipment where specified or as may reasonably be requested by the Engineer for review before ordering same in accordance with Division 1. The Engineer may retain the samples until the completion of the contract.

1.11.12 Complete all work in accordance with reviewed shop drawings.

1.11.13 Where conduits, cable trays and lay-in ducts are not detailed, submit conduit, cable tray and wiring layout drawings. Show conduit/tray and cable sizes including number of cables/conductors in each conduit/tray. Drawings shall be on the same size sheets as the contract drawings.

1.11.14 Provide reviewed single line diagram of electrical distribution systems mounted in metal frame located in pump room near service entrance equipment.

1.11.15 Indicate the number, letter or equipment tag used on the drawings/specifications as an identification symbol on product data for MCCs, transformers, panelboards, light fixtures, and other equipment submitted.

1.11.16 Bind one complete set of construction/shop drawings showing “as built” conditions in each operating and maintenance instruction manual.

1.11.17 Electrical equipment shop drawings will not be reviewed unless they are preceded by or accompanied with a copy of the electrical protection, coordination and arc flash study. The electrical equipment shop drawings will be returned as rejected, if submitted prior to the protection, coordination and arc flash study

1.12 Record Drawings

1.12.1 Comply with requirements for record drawings stated in 01330 – Submittals.

1.12.2 Before commencing work, obtain two sets of electrical drawings for showing “As Built” conditions. As job progresses, mark on field set of prints to indicate accurately all installed work. At completion stage, transfer all information onto master set of drawings and indicate “Contractors Certified Approval of Accuracy” before submitting to Engineer for review and record use.

1.12.3 Indicate on record drawings “As Built” stamp.

1.12.4 Show on the record drawings as-built, all outlets and equipment such as runs of conduit, locations of pull boxes, light fixture locations, equipment, outlets, motors, panels, etc., as well as all services entering the building and on the property.

1.12.5 Dimension underground services and concealed main and sub-feeder conduits at key points of every run in relation to structure and building. Record all elevations for underground services in relation to the ground floor level of the building. Indicate on record drawings, location of all buried services. This information is to be certified correct by Engineer before backfilling commences.

1.12.6 Indicate exact location of all services left for future work.

1.13 Operations and Maintenance Manuals

1.13.1 Comply with requirements for operating and maintenance manuals stated in 01330 – Submittals.

1.13.2 In addition to the requirements of 01330 – Submittals, include in the Operations and Maintenance Manuals:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature are not acceptable.

.3 Wiring and schematic diagrams and performance curves.

.4 Names and addresses of local suppliers for items included in Maintenance Manuals.

.5 Copy of test data.

.6 List of spare parts of all electrical equipment complete with names and addresses of sales, service representatives and suppliers.

.7 A motor list showing each motor number, name, horsepower, full load amps, overload settings, nameplate, current rating, heater size and type, and current being drawn, etc.

.8 Copy of final inspection certificate.

.9 Copy of the purchase order, showing equipment make and model numbers issued to the manufacturer complete with all addenda. All cost details may be hidden.

.10 Copy of all warranty certificates.

.11 Set of final reviewed Shop Drawings.

1.14 Voltage Ratings

1.14.1 Operating voltages: CAN2-C235-83

1.14.2 Control and distribution devices and equipment to operate satisfactorily under the extreme operating conditions established in the above standard without mis-operation or damage to equipment.

1.15 Site conditions

1.15.1 Voltage Supply, 600 V: 3-phase, 4-wire, solidly grounded.

1.15.2 Voltage Supply, other: as shown on drawings.

1.15.3 Temperature range:

.1 Indoor: 10°C to 40°C

.2 Outdoor: -35°C to +40°C

1.15.4 Altitude: <1000 m ASL

2 PRODUCTS

2.1 Materials and Equipment

2.1.1 Unless otherwise indicated, all equipment shall be new, of first quality, and wherever possible shall be of a manufacturer's standard design.

2.1.2 Equipment and material must be certified to a recognized Canadian standard (CSA, CUL, etc.).

.1 Where listed equipment is not available, obtain special approval acceptable to the ESA and pay all associated fees.

2.1.3 Unless otherwise indicated all equipment shall conform to customary North American standards (e.g. NEMA, ANSI, ASTM, CSA, etc).

2.1.4 Factory-assemble control panels and component assemblies.

2.1.5 All new electrical wiring, equipment, and new local control panels are to be supplied to meet the electrical and environmental classifications of area in which they are to be installed.

2.1.6 Equipment and material must be CSA certified. Where there is no alternative to supplying equipment that is CSA certified, obtain special approval from Electrical Inspection Department. Pay all associated fees and perform all required retrofits to obtain special inspection certification.

2.1.7 CSA labels shall be visible and legible after equipment is installed.

2.2 Finishes

2.2.1 Unless otherwise noted in the equipment sections or drawings, finish all equipment as follows.

2.2.2 All shop finishes for steel enclosures shall include cleaning, iron phosphate wash, rinsing, rust resistant primer inside and outside, and at least two coats of finish enamel with appropriate baking to cure each paint application.

2.2.3 Colours:

.1 Paint outdoor electrical equipment "equipment green" finish to ANSI C57.12.28.

.2 Paint indoor switchgear and distribution enclosures ANSI- 61 light grey (Munsell 8.3G 6.1/05) to EEMAC 2Y-1-1958.

.3 Paint the interior of control compartments semi-gloss white.

2.2.4 Stainless steel enclosures shall not be painted.

2.2.5 Paint and primer application shall be power coat unless otherwise specified or approved in writing by the Engineer.

2.2.6 On site, clean and touch up any scratched or marred surfaces of on shop painted equipment scratched or marred during shipment or installation, to match original paint.

2.2.7 Break and deburr all edges.

2.2.8 Clean and prime exposed nongalvanized and non-stainless hangers, racks and fastenings to prevent rusting.

2.3 Enclosure Ratings

2.3.1 Enclosure ratings to be as follows unless indicated otherwise in the contract documents:

.1 Below grade, damp or outdoor locations: NEMA 4X or as noted on drawings.

.2 Classified areas (if required): to suit area classification and NEMA 4X.

2.4 Equipment identification

2.4.1 All equipment, wiring and conduits shall be identified as described in 16090 and in the contract documents.

2.5 Warning Signs

2.5.1 As specified and to meet requirements of Electrical Inspection Department and Engineer.

2.5.2 Decal signs, minimum sized 175 x 250mm.

2.5.3 Protect exposed live equipment during construction for personnel safety.

2.5.4 Shield and mark live parts with appropriate voltage values in English.

2.6 Insert, Sleeves, Fastenings and Supports

2.6.1 Provide all necessary inserts, hangers, fastenings, sleeves and curbs for electrical equipment, suspended from or passing through structural walls or floors, to suit the specific location, and as approved by the Engineer.

2.6.2 Sleeves: allow 12 mm clearance over the O.D. of all cables and conduits, 25 mm horizontally and vertically for rectangular openings.

3 EXECUTION

3.1 General

3.1.1 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. Install and connect all electrical and instrumentation equipment, controls and devices supplied under other sections. The word “provide” shall be defined to mean supply and install.

3.1.2 The use of permanent electrical system for temporary construction service shall be only with written permission of the Engineer.

3.1.3 Maintain at the job site, at all times, qualified personnel and supporting staff, with proven experience in erecting, supervising testing projects of comparable nature and complexity.

3.1.4 Expedite the work as follows:

.1 Continuously check and expedite delivery of equipment and materials.

.2 If necessary, inspect at the source of manufacture.

.3 Continuously check and expedite the flow of necessary information to and from all parties involved.

.4 Inform the Engineer promptly where information is required.

3.1.5 The work of this division shall be coordinated with other divisions in such a manner as not to interfere with other work. In areas where the ducts, pipes, wiring and equipment for other sections will be installed in proximity to pipes, wiring and equipment pertaining to this division, cooperate to ensure that all pipes, ducts, wiring and equipment are installed to the best advantage.

3.1.6 Equipment, conduit, etc., installed but not coordinated with the work of other trades shall be relocated as directed by the Engineer without extra cost to the Owner.

3.1.7 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance and to function properly to the satisfaction of the Engineer. Install exposed conduit runs parallel and perpendicular to building planes. Install conduit concealed in chases, behind furring, or above ceiling, except in unfinished areas. Install exposed systems neatly and group to present a neat appearance.

3.2 Workmanship

3.2.1 Install all equipment, conduit and cables in a workmanlike manner to present a neat appearance and to function properly.

3.2.2 Install exposed systems and equipment neatly and grouped to present a neat appearance, without conflict to other services.

3.2.3 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore, in terms of space and accessibility.

3.2.4 Include in the work all requirements of manufacturers shown on the shop drawings or manufacturers' installation instructions, and make provision for future and equipment as shown.

3.2.5 Replace without extra cost work unsatisfactory to the Engineer.

3.2.6 Protect all equipment from damage during delivery to the site and during installation. Make good any damage or deterioration whatsoever and have it covered by replacement guarantee.

3.2.7 Contractor is required to provide as-built single line diagrams (SLD) using AutoCAD on a laminated board size 'D'.

.1 The SLD is to be consistent with the as built condition of the pumping station.

.2 Provide an SLD in the new pump room.

3.3 Pre-construction Inspection

3.3.1 The Contractor is required to visually inspect the existing site conditions, including below grade areas, prior to the project award, to suit the installation of the new power and controls distribution. The Contractor is required to coordinate the installation of the new power/control infrastructure with the existing conditions and services.

3.3.2 The Contractor is required to visually inspect the existing building conditions, including below grade areas, prior to the project award, to suit the installation of the new power and controls distribution. The Contractor is required to coordinate the installation of the new power/control infrastructure with the existing conditions and services. The Contractor shall verify all existing conditions including building services that are in close proximity to the proposed cable installation as shown on the drawings.

3.4 Excavation and Backfill

3.4.1 Ensure that route and depth of excavation for underground electrical services are as indicated. Provide protective materials around and over services and be present at all times during excavation and backfilling to supervise work.

3.5 Cutting, Patching and Welding

3.5.1 Conform to the requirements of Division 1 in respect to cutting, patching, and fitting electrical equipment.

3.5.2 Where installation of equipment by this section requires cutting or patching of new or existing work, the work shall be performed by, and under direction and supervision of, this section. Make good surface finishes to satisfaction of the Engineer.

3.5.3 Locate and provide holes and sleeves required for electrical work. Relocate improperly located holes and sleeves at no cost.

3.5.4 Finish sleeves flush with wall finish (each side) or the ceiling to curb top.

3.5.5 No cutting or welding of beams, columns or structural surfaces is permitted without approval of the Engineer and all damage to finished or unfinished surfaces shall be made good to the satisfaction of the Engineer.

3.5.6 Pay all costs for cutting and patching resulting from failure to co-ordinate timely installation of electrical inserts, sleeves, etc., into masonry structures.

3.6 Securing of equipment

3.6.1 Secure equipment to poured concrete with expandable inserts, properly sized for the load to be carried.

3.6.2 Secure equipment to hollow masonry walls or suspended ceilings with factory made threaded or toggle type inserts, properly sized for the load to be carried.

3.6.3 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields, properly sized for the load to be carried.

3.7 Mounting Heights

3.7.1 Mounting height of equipment is from finished floor to centerline of equipment

3.7.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.7.3 No controls shall be mounted at greater than 1800 mm above finished floor or grade.

3.8 Conduit and Cable Installation

3.8.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be plastic, sized for free passage of conduit, and protruding 50mm either side.

3.8.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

3.8.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

3.9 Wiring - General

3.9.1 Unless otherwise indicated on the drawings all power and control wiring shall be installed in surface-mounted conduit.

.1 Conduit types shall be as indicated in Section 16133.

3.9.2 Provide spare conductors as follows:

.1 10% or minimum three (3) spare conductors in each 120 V power conduit

.2 20% spare control wiring or minimum four (4) spare conductors in each control-wiring discrete control signal conduit

.3 20% or minimum one (1) analog twisted shielded pair which ever quantity is greater.

.4 20% spare control conductors in each multi-conductor armoured discrete control cable.

3.9.3 Provide space for 20% additional conductors in each low voltage power and control conduit and box.

3.9.4 All conductors are to be continuous with no splices for each application.

3.9.5 All conductors shall be stranded copper unless otherwise indicated.

3.9.6 All wiring shall be identified in accordance with 16090.

3.9.7 Provide a dedicated green jacket bond conductor in all raceways including PVC and metallic conduits.

3.9.8 Provide a ground/bond conductor to suit all power distribution wiring applications. Unless otherwise indicated on the drawings the ground conductors are to be sized in accordance with the Ontario Electrical Safety Code – Latest Edition.

3.10 Wiring Terminations

3.10.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

3.10.2 Where stranded conductors terminate on a screw terminal, the conductor will be terminated with a full ring terminal.

3.10.3 Under no circumstances will more than one (1) conductor or ground be installed in a screw type connector, lug or terminal block.

3.11 Cleaning

3.11.1 Comply with Section 01000 – General Requirements.

3.11.2 Before energizing any system, inspect and clean all the inside of all electrical enclosures to ensure that they are free from dust and debris.

3.11.3 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.

3.11.4 Clean all polished, painted and plated work brightly.

3.11.5 Remove all debris, surplus material and all tools.

3.12 Field Quality Control (Testing)

3.12.1 Prior to the Owner's acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Engineer to ensure that the operation of the system and components satisfy the requirements of the Contract Documents.

3.12.2 Comply with requirements of:

.1 Section 01810 – Testing and Commissioning

3.12.3 All equipment and electrical systems which are provided under this Division shall be performance tested for electrical and mechanical defects and all defects and adjustments made, prior to requesting inspection by the Engineer.

3.12.4 Tests requiring initial power-up of a system shall not be made without notification of the Engineer.

3.12.5 Carry out tests in presence of Engineer.

3.12.6 Furnish labour, materials, instruments and bear all costs for tests as requested by the Engineer.

3.12.7 Conduct all testing by fully qualified personnel only.

3.12.8 In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required by other Divisions where electrical services are involved and make final adjustments to the electrical controls at no additional cost to the Engineer.

3.12.9 Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.

3.12.10 Clean all equipment prior to testing.

3.12.11 Ensure that the system and its components are ready prior to the inspection and test for acceptance.

3.12.12 All testing shall be scheduled and coordinated through the Engineer. No testing of any kind shall be done without this clearance. Give three (3) working days' notice of proposed tests.

3.12.13 Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.

3.12.14 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.

3.12.15 Document all testing. Record test procedures, acceptable results, actual results, remedial work performed and final outcome.

3.12.16 Submit original copies of letters from the manufacturers of auxiliary systems indicating that their technical representatives have inspected and tested the respective systems and are satisfied with the methods of installation, wiring and operation.

3.12.17 Submit two (2) copies of test results for Engineer's review in addition to copies included in maintenance data.

3.12.18 Replace at no additional cost all fuses, relays, or other devices destroyed during field quality control testing.

3.13 Care, Operation, and Start-up

3.13.1 Instruct Engineer and operating personnel in the operation (testing), care and maintenance of equipment.

3.13.2 Arrange and pay for services of manufacturer's factory service engineer to supervise startup of installation, check, adjust, balance and calibrate components.

3.13.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

3.14 Trial Usage

3.14.1 The Owner and Owner's representatives shall have the privilege of trial usage of the electrical system or parts thereof for the purpose of testing and verifying operational procedures.

3.14.2 Trial usage by the Owner shall not waive the Contractor/Sub-Contractor of any responsibility because of trial usage.

3.14.3 Trial usage shall not be construed as acceptance by the Owner.

3.15 Demonstration and Training

3.15.1 Instruct Owner's personnel in the operation, care and maintenance of equipment. Perform demonstration and training in accordance with project requirements.

END OF SECTION

Electrical Safety Authority
www.esasafe.com

400 Sheldon Dr, Unit 11, Cambridge, ON , N1T 2H9
For inquiries:
TOLL FREE TEL: 1-800-746-6480

Low Voltage Report

CIMA CANADA INC
Attn: Dmitri Chilov 4165591251
5935 AIRPORT RD SUITE 500
MISSISSAUGA ON L4V 1W5

NOTICE DATE:	October 20, 2025
NOTIFICATION #:	40067437
PLAN REVIEWER:	Coyle, Brandon
INSPECTOR:	McWilliams, Aaron
TELEPHONE:	(705)541-8010
PRINT DATE:	October 20, 2025
CUSTOMER ID:	59835
CUST. ORDER #:	T001592B

Subject property:
BLIND RIVER INTAKE AND LLPS - 200A
SLD E07 R0
15 MARTIN ST
BLIND RIVER ON P0R 1B0

This office has examined the plans submitted by you for the low voltage portion of the above-noted installation. Work may commence on the project provided the installation is made in accordance with the submitted plans and specifications, the Ontario Electrical Safety Code and its supplements together with the following comments. Final approval of the installation is subject to field inspection.

Electrical Safety Authority

400 Sheldon Dr, Unit 11, Cambridge, ON , N1T 2H9
For inquiries:
TOLL FREE TEL: 1-800-746-6480

www.esasafe.com

1. This plan review is based on the Ontario Electrical Safety Code, 29th Edition / 2024.

2. All equipment must be approved by an accredited Certification Body, or accepted through field evaluation, or accepted by an Inspector under the provisions of Rule 2-024 of the current Ontario Electrical Safety Code. Rule 2-022, Rule 2-024, Bulletin 2-7-*

3. All electrical equipment shall be installed in accordance with any specific manufacturer's instructions in addition to the minimum Code requirements. Rule 2-034

4. The drawings indicate a Category 1 location. All equipment within the Category 1 location shall be suitable for wet locations. Rule 22-002 a) and Rule 22-102 1)

5. The drawings indicate a Category 2 location. All equipment within the Category 2 location shall be corrosion-resistant. Rule 22-002 b) and Rule 22-102 2)

6. At each distribution point, circuit breakers, fuses and switches shall be marked, adjacent thereto, in a conspicuous and legibl manner to indicate clearly which installation or portion of installation they protect or control and the maximum rating of overcurrent device that is permitted. Rule 2-100 3)

7. Available fault current not provided. All overcurrent protection shall be capable of interrupting the available fault current. Rule 14-012, Bulletin 14-4-*

An invoice will be sent directly to your Accounts Payable Department. If we may be of any assistance regarding any aspect of this installation, particularly with respect to clarification of the above comments and regulations, please contact the Plan Review Department or the Inspector listed above.

Pour obtenir une version francaise du rapport, veuillez appeler 1-877-372-7233.

1 GENERAL

1.1 Purpose

1.1.1 The specification describes the requirements for the following studies:

.1 Short circuit analysis, device evaluation and coordination study (SCCS)

.2 Arc flash hazard analysis study (AFHS)

1.1.2 The specification describes the requirements for:

.1 Setting and verifying the operation of protective devices

.2 Arc flash hazard labelling

1.2 Scope of Work

1.2.1 The Contractor and/or their supplier of analysis services shall, as defined in this section:

.1 Investigate the existing system to gather data for the analysis.

.2 Obtain the necessary characteristics of equipment supplied under the contract

.3 Obtain utility fault data from the Supply Authority

.4 Prepare a short circuit analysis

.5 Verify all equipment duties and make recommendations where equipment is underrated

.6 Prepare a coordination study

.7 Prepare an arc flash hazard analysis and prepare recommendations to reduce arc flash hazards

.8 Set all protective devices

.9 Apply Arc Hazard labels

.10 Field test, inspect and verify all protective devices

1.2.2 The Short Circuit Analysis, Protection Coordination Study and Arc Flash Hazard Analysis shall include all new 600V power distribution system equipment under this project as well as all upstream equipment affected by the project including:

.1 New equipment and power distribution system

.2 New MCCs

.3 New utility transformer

.4 New generator

1.3 General Requirements

1.3.1 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section.

1.3.2 Equipment and component titles used in the studies shall be identical to the equipment and component titles shown on the drawings.

1.3.3 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section.

1.3.4 The Contractor is responsible for providing appropriate arc flash safety equipment and procedures when opening live equipment.

1.3.5 The analysis shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.

1.3.6 This Section covers items common to Sections of Division 16. This section supplements requirements of Division 1.

1.4 Definitions

1.4.1 The following are definitions of terms and expressions used in the specification:

.1 “Inspection Department/Authority” means an agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site. For this project the Inspection Authority is the Electrical Safety Authority (ESA).

.2 “Provide” means to supply, implement, test, verify and implementation of recommendations related to analysis works.

.3 “Electrical Code” means Ontario Electrical Safety Code, 2024 edition.

.4 “Indicated” means as shown on contract drawings or noted in contract documents.

.5 “Supply Authority” means the local electrical distribution company. For this project the Supply Authority is Hydro One (Networks Inc).

1.5 Codes and Standards

1.5.1 Perform work and supply equipment in compliance with the latest editions of the Ontario Electrical Safety Code and all local codes and requirements, which govern the installation.

1.5.2 Perform SCCS in accordance with IEEE 242

1.5.3 Perform arc flash analysis and prepare labels in accordance with CSA Z462.

1.5.4 Perform harmonic analysis in accordance with IEEE 519.

1.6 References

1.6.1 Read and conform to the General Requirements (Division 1), which applies to and forms part of all sections of the work. The general instructions are intended to supplement and not to replace Division 1 requirements.

1.6.2 The following is a list of standards which may be referenced in this section:

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.2 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems

.3 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

.4 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis

.5 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings

.6 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.6.3 Canadian Standards Association (CSA)

.1 CSA C22.2 No.0 for “Definitions and General Requirements”.

.2 CSA Z85 for abbreviations for electrical terms:

1.7 Co-ordination – Supply Authority

1.7.1 Co-ordinate with the power supply authority to obtain utility fault contribution data.

1.7.2 Obtain specific fault contribution data for each utility feeder circuit that supplies power to the Pumping Station. Where feeders can be fed from multiple stations, obtain the fault current from each station

1.7.3 Obtain the design short circuit level from the supply authority for the device evaluation.

1.7.4 Arrange for access to equipment controlled by the supply authority as required to suit the analysis works.

1.7.5 Pay all costs levied by the supply authority for site assistance or access to equipment that is under the care and control of the supply authority. Pay for, schedule, and obtain station guarantees from the supply authority as required to suit data gathering.

1.8 Coordination – Electrical Safety Authority

1.8.1 Provide copies of the approved studies to ESA as required.

1.8.2 Make all changes required by ESA and resubmit the study to the Owner and the ESA. All changes required to satisfy ESA shall be made at no cost to the owner.

1.8.3 Arrange for and pay for any ESA Inspections that are required to re-energize equipment.

1.9 Coordination - General

1.9.1 Coordinate with the owner's staff for access to fenced areas, buildings, and rooms for the purpose of data gathering and verification.

1.9.2 The Contractor shall provide a schedule to the owner indicating the locations that will require access by the contractor's staff. The contractor shall provide a schedule 5 business days in advance of the proposed location access for review and approval by the owner.

1.9.3 In case of a discrepancy between statement(s) or value(s) between the specifications, contract drawings, codes and referenced standards, the more stringent statement or value shall take precedence and shall govern.

1.9.4 The shop drawings for electrical equipment operating at 600 V and above shall not be reviewed without the device evaluation study.

1.10 Quality Assurance

1.10.1 One firm shall be employed to perform the data gathering, analysis and verification.

1.10.2 The study agent shall not perform device settings. All device settings shall be performed by the manufacturer or their designated representative.

.1 The Contractor may perform device settings where properly trained and when authorized by the manufacturer.

.2 Where existing device settings are modified, the study agent shall make the changes and the Contract Administrator shall verify the changes.

1.10.3 The firm should be currently involved in the preparation of high and low voltage power system studies of the type required herein.

1.10.4 The firm performing the study shall demonstrate experience and training in the following:

.1 The relevant analysis procedures

.2 Use of the required analysis software

.3 Operation of the required testing instruments

.4 Operation, setting and verification of the protective devices covered by the studies

1.10.5 All studies and verification reports shall be supervised, stamped and signed by a Professional Engineer registered in the Province of Ontario.

.1 The stamping Engineer shall have a minimum of five (5) years of experience in power system analysis.

1.10.6 All testing devices shall be calibrated in accordance with the manufacturer's requirements and, where applicable, to a NIST recognized standard.

.1 All equipment shall have up-to-date calibration marks.

.2 Any testing done with uncalibrated equipment shall be repeated at no cost to the Owner.

1.11 Submittals

1.11.1 Provide the following submissions to the Contract Administrator:

.1 Preliminary information

.2 Short Circuit Study and Protective Device Evaluation

.3 Protection Coordination Study

.4 Arc Flash Hazard Analysis including Arc Flash stickers in accordance with CSA Z462

.5 Protective device setting sheets

.6 Settings and device verification report

.7 As-set device files

1.11.2 The purpose and format of the submissions shall be as follows:

Submission	**Purpose**		**Format**		
	Review & Approval	**Info**	**Electronic (pdf)**	**Electronic (native)**	**Paper**
Preliminary information	x		x		
Short Circuit Study and Protective Device Evaluation	x		x		x
Protection Coordination Study	x		x		x
Arc Flash Hazard Analysis	x		x		x
Protective device setting sheets	x		x		x
Settings and device verification report		x	x		x
As-set device files		x		x	

.1 Paper Submissions Requirements

.1 The studies shall be separately bound in individual binders.

.2 Pages that contain colour, including charts, graphs, warning labels, shall be printed in colour.

.3 All diagrams, tables and charts shall be printed on a suitable size to allow clear reading.

1.12 Submittals - Preliminary Information

1.12.1 Provide the following information:

.1 Credentials of the firm and stamping Engineer

.2 Proposed distribution system arrangements for the SCCS and AFHS

.3 The software used for the analysis

1.12.2 Submit for approval prior to commencing any work under the section.

1.13 Submissions - Short Circuit Study and Protective Device Evaluation

1.13.1 Provide a report containing the following:

.1 Descriptions, purpose, basis and scope of the study

.2 Calculation methods and assumptions, the base per unit quantities selected, source impedance data including power company system characteristics.

.3 Fault current calculations including a definition of terms and guide for interpretation of computer printout.

.4 Input data tables showing:

.1 Short circuit reactance of rotating machines

.2 Cable and conduit material data

.3 Bus data

.4 Transformer data

.5 Circuit resistance and reactance values

.5 Calculation tables showing:

.1 Symmetric and asymmetric fault current for 3 phase faults and ground faults

.2 Fault contribution from all motors greater than or equal to 100hp at all voltages.

.3 Fault contribution from all generators and utility sources

.4 Maximum available fault currents, 3 phase and phase-to-ground for all busses

.5 Maximum available fault current RMS symmetrical at each protective device.

.6 Fault impedances.

.7 X to R ratios.

.8 Asymmetry factors.

.6 Evaluation tables showing:

.1 Interrupt ratings of all existing distribution equipment showing protective devices ratings versus calculated short circuit duties, and commentary, and commentary regarding same.

.2 Equipment “Pass” or “Fail” given available fault levels

.3 The name, description, locations and voltage level of the respective equipment in the summary table.

.4 Fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

.7 Establish settings to all protective devices in the distribution system, including devices with fixed protection characteristics.

.8 A Single Line Diagram from the analysis software showing the parameters for all new and existing electrical distribution system devices used in the analysis and the names and/or tags of all distribution equipment

.9 Single Line Diagrams from the analysis software showing the worst-case interrupting and withstand short circuit current levels at each bus.

1.13.2 Provide a copy of the analysis model in its native format.

1.14 Submissions - Protection Coordination Study

1.14.1 Provide a report containing the following:

.1 Descriptions, purpose, basis and scope of the study

.2 The approved Short Circuit Study and Protective Device Evaluation

.3 Time-current curves (TCC) graphically indicating the coordination proposed for the system, centred on conventional, full-size, log-log forms.

.4 Include with each TCC sheet complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet.

.5 Tabulations of all protection and configuration settings for each microprocessor based protection relays including multifunction protection relays for branch feeders and motor protection relays.

1.14.2 Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics.

1.14.3 Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

1.14.4 Include on the curve sheets power company relay and fuse characteristics, system medium voltage equipment relay and fuse characteristics, low voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. Include at least

all devices down to largest branch circuit and largest feeder circuit breaker in each motor control centre, and main breaker in branch panel-boards. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400 or 600% currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault current to which the device is exposed.

1.14.5 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

.1 Fault contribution from the Emergency Generator System

.2 Feeder cables thermal short circuit damage curve.

.3 Primary fusing for protection of the transformers.

.4 Power transformer thermal short circuit damage curve, 3 phase, phase to ground.

.5 Largest 600V moulded case distribution breaker and characteristics.

.6 Largest distribution transformer thermal short circuit damage curve.

.7 Main 120/208V distribution breaker and characteristics.

1.14.6 Provide a copy of the analysis model in its native format.

1.15 Submissions - Arc Flash Hazard Analysis

1.15.1 Provide a report containing the following:

.1 Descriptions, purpose, basis and scope of the study.

.2 The approved Short Circuit Study and Protective Device Evaluation

.3 The approved Protection Coordination Study

.4 Tabulations of the arc flash hazard data and incident energy for each bus and distribution point.

.5 Recommendations to reduce arc flash hazard levels.

.6 Colour printouts on paper of the application specific Arc Flash Hazard warning labels that will be applied in the field.

.7 A sample arc hazard label for approval

.8 A Single Line Diagram from the analysis software showing the Incident energy levels at each bus, distribution point

1.15.2 Provide a copy of the analysis model in its native format.

1.16 Submissions - Protective Device Setting Sheets

1.16.1 Provide detailed data sheets for all relays and monitors within the scope of this study, including all multifunction relays, feeder protection relays, motor protection relays showing:

.1 Protective device setting parameters

.2 Allowable parameter ranges

.3 Parameter setpoints

.4 Output relay functions

.5 Parameters for input devices

.6 Internal logic settings

.7 Communications parameters and addresses

1.17 Submissions - Settings and Device Verification Report

1.17.1 Provide a report for each tested device that shows the following:

.1 The operator and equipment used to include equipment make, model, serial number and calibration information.

.2 Environmental conditions at time of testing

.3 Test procedure

.4 Expected and/or acceptable test result

.5 Actual test results

.6 Remedial action taken to achieve compliance with the test goals

.7 Outstanding deficiencies and recommended remedial action required.

1.18 Submissions - As-set device files

1.18.1 Provide all as-built multifunction solid state relay files in their original format on compact disk.

1.18.2 Provide a pdf of the as-left device setting sheets on the same compact disk.

1.19 Software Products

1.19.1 The Contractor shall utilize a reputable software product to produce the respective analysis works, including the Short Circuit Study and Protective Device Evaluation, Protection Coordination, and Arc Flash Hazard Analyses

1.19.2 The studies shall include all portions of the electrical distribution system from the normal power source or sources down to and including the smallest adjustable trip circuit breaker in

the distribution system. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

1.19.3 The Contractor shall gather all required data prior to commencing analysis.

1.20 Short Circuit and Protective Device Evaluation and Coordination Study

1.20.1 Calculate the short circuit interruption and momentary (when applicable) duties for an assumed 3-phase bolted fault at each:

.1 Supply Authority point of common coupling

.2 Primary voltage equipment including aerial fused interrupters, underground distribution switchgear, unit substation primary and secondary terminals, etc

.3 Secondary equipment including switchgear, switchboards, motor control centres, distribution panel-boards, generators, motors or loads, etc. operating at greater than 300 V L-L

.4 Pertinent branch circuit panel-board operating at less than 300 V L-L.

.5 Other significant locations throughout the system

1.20.2 Calculate the ground fault current study for the same system areas, including the associated zero sequence impedance data.

1.20.3 Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on drawing one-lines.

1.20.4 Source combination may include present and future power company supply circuits, large motors, or generators.

1.20.5 Include fault contribution of all motors in the study. Notify the Construction Manager in writing of circuit protective devices not properly rated for fault conditions.

1.20.6 Utilize equipment load data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.

.1 Verify:

.1 Equipment and protective devices are applied within their ratings.

.2 Adequacy of switchgear and motor control centres bus bars to withstand short circuit stresses.

.3 Adequacy of transformer windings to withstand short circuit stresses.

.4 Cable and busway sizes for ability to withstand short circuit heating, besides normal load currents.

1.20.7 When an emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along

with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

1.21 Coordination Study

1.21.1 Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics; including a point equal to 58% of the ANSI withstand point to provide secondary line-to-ground fault protection.

.1 Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve.

.2 Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16% current margin to provide proper coordination and protection in the event of secondary line-to-line faults.

1.21.2 Separate medium voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.

1.21.3 Ratios of all Current Transformers (CT's), utilized in the electrical distribution system, are to be verified by the protection coordination study to ensure compatibility of the proposed protection coordination settings. The contractor is required to coordinate all ratios identified on the respective electrical distribution equipment shop drawings with the protection coordination study

1.21.4 Evaluate proper operation of the ground relays in 4-wire distributions with more than one (1) main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.

1.21.5 The study shall provide analysis and coordination to suit all possible operational configurations of the 600V distribution systems that will supply the new 600V loads.

1.22 Arc Flash Hazard Analysis

1.22.1 Provide an Arc Flash Hazard Analyses to suit the new electrical distribution systems. The analysis shall include all new distribution systems and existing distribution equipment that will supply the new electrical installations.

1.22.2 The Arc Flash Hazard analysis shall be an Incident Energy Analysis per CSA Z462 and the calculations shall be performed according to IEEE 1584 and NFPA 70E.

1.22.3 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented for approval.

1.22.4 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centres, panel boards, busway and splitters and motors) where work could be performed on energized parts.

1.22.5 The Arc-Flash Hazard Analysis shall include all significant locations in 600V and 208V systems fed from transformers equal to or greater than 125 kVA.

1.22.6 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on latest IEEE 1584 and NFPA 70E.

1.22.7 Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering incident energy of 1.2 Cal/cm2.

1.22.8 Where the Hazard/Risk Category exceeds 2 (8 cal/cm2), make recommendations to reduce the incident energy.

1.22.9 The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

1.22.10 Arc flash computation shall be performed for both line and load side of main breakers for all MCCs, Switchboards and Switchgear.

1.23 Arc Flash Warning Labels

1.23.1 The Contractor shall provide 90mm x 130mm thermal transfer type label of high adhesion polyester for each work location analysed.

1.23.2 The label shall have an orange header with the wording, “WARNING, ARC FLASH HAZARD”, and shall include the following information:

.1 Location designation

.2 Nominal voltage

.3 Flash protection boundary

.4 Hazard risk category (PPE level)

.5 Incident energy

.6 Working distance

.7 Engineering report number, revision number and issue date.

1.23.3 Labels shall be machine printed in colour, with no field markings.

1.23.4 Labels shall meet requirements of CSA Z462.

1.23.5 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

.1 For each 600V, and applicable 208V panel boards, one arc flash label shall be provided.

.2 For each motor control centre, one arc flash label shall be provided.

.3 For each low voltage switchboard, one arc flash label shall be provided.

.4 For each switchgear, one flash label shall be provided.

.5 For medium voltage switches\breakers one arc flash label shall be provided

.6 For medium voltage starters one arc flash label shall be provided.

1.24 Approved Coordination Study and Arc Flash Hazard Analysis Providers

.1 Eaton Cutler Hammer Engineering Service

.2 Brozs Technical Services

.3 Schneider Electric

.4 Approved Equivalent

2 PRODUCTS

2.1 Test Reports

2.1.1 Provide all tests results with typed test reports and signed field test sheets.

2.1.2 All test sheets to include equipment nameplate data, customer identification, time and date of tests, environmental conditions during tests, and test results.

3 EXECUTION

3.1 Data gathering

3.1.1 Prior to analysis, the examine the existing electrical distribution system and obtain and/or verify all background information required by the analysis services including:

.1 New and existing distribution equipment ratings

.2 All distribution system loads

.3 All distribution cable ratings & lengths

.4 Locations of all distribution equipment and related loads

.5 Location, nameplate data and settings of all overcurrent protection devices, including breakers, electromechanical relays, fuses, and solid state multifunction relays.

3.1.2 Verify the accuracy of any information and/or documentation that is obtained from the owner or other sources in the course of data collection to suit the analysis works.

3.1.3 Provide a licensed electrician to gain access to any existing distribution equipment to suit verification of existing electrical name plate data as required.

3.2 Protective relay settings

3.2.1 The Contractor shall adjust existing relay and protective device settings according to values established by the approved coordination study.

3.2.2 The equipment manufacturer and/or their representative shall adjust all new relay and protective device settings according to values established by the approved coordination study.

3.2.3 Provide all necessary equipment and/or software to setup new and existing Electronic, Solid-state Multifunction Protection Relays.

3.3 Protective relay verification

3.3.1 Perform functional testing for the following types of protective device:

.1 Protective relays with adjustable settings, new and existing.

.2 Devices with fixed protection settings (e.g. Thermal-Magnetic breakers) with ratings in excess of 200A

.3 All ground-fault alarm or trip devices

.4 Ancillary protective devices including transformer overcurrent devices, temperature sensors, etc.

3.3.2 Perform visual inspection for all protective devices supplied under the contract and for existing devices including within the coordination and/or arc flash hazard studies.

3.3.3 General Procedure

.1 Carry out tests in the presence of the Construction Manager and a representative of the owner

.2 Notify the Construction Manager of the protection system testing. Provide 5 business days advanced notice prior to scheduling testing.

.3 Carry out the work with trained personnel, experienced in the particular type of testing and procedures required for each protection application.

.4 Ensure suitable power supply is available for test equipment.

.5 Record make, model and calibration date of test instrument.

.6 Conduct inspection and tests and compile test results on approved relay test sheets.

.7 Make minor modifications (relay setting changes, fuse changes) to equipment as required to accomplish conformance with the short circuit and protective device coordination studies.

3.3.4 Deviations and Defects:

.1 Ensure that any defects discovered are noted and corrected before continuing work.

.2 Mark any deviations found, initially on one set of the report analysis documents. Revise the protection coordination study report as required to suit as-left conditions.

.3 Revisions, further test results and clarifications of comments shall be incorporated into the test reports.

.4 Notify Construction Manager in writing of any required major equipment modifications.

3.3.5 Functional Testing

.1 Ensure all protective and metering devices are set-up as per the coordination study settings. These settings include relay protective settings, output and input relay assignments.

.2 Conduct tests on all protective relays including relays, auxiliary voltage and current relays, overloads, speciality protection relays, trip supervisory relays and trip relays.

.3 Tests to include all protective features, verification of current transformer, voltage/potential transformer settings, relay input and output functions, communication acceptance.

.4 Use special test set and test methods as available from relay manufacturer. Take all recommended manufacturer's precautions.

.5 Provide all necessary equipment and/or software to test existing Electronic, Solid-state Multifunction Protection Relays.

.6 Simulate all inputs to test for correction output operation.

.7 Verify all interlocks.

.8 Prove all logic, both hardwired and internal.

.9 Perform secondary current and/or voltage injection testing for all over current protection devices, including breakers and/or relays to simulate all fault conditions to demonstrate the coordination study settings.

.1 Use three-phase test sets where required.

3.3.6 Visual Inspection

.1 Inspect all devices not covered by the functional testing requirements.

.1 Verify the presence of the device and that the rating and type matches the approved coordination study.

.2 Verify the condition of all devices and ensure that wiring is correct and check for conditions that would impair operation.

.3 Verify that identification tags match the approved study and/or single line diagram.

.2 Record results in a log book or worksheet and submit with record drawings.

3.4 Arc flash Hazard labels

3.4.1 The Contractor shall install the arc Flash Hazard Labels.

.1 Clean all surfaces prior to installing labels.

.2 Labels shall be neatly installed with their edges parallel to the equipment.

.3 Labels shall not mask other labels or operating controls.

.4 Labels that are installed in a manner deemed unsuitable by the Contractor Administrator shall be replaced at no cost to the Owner.

3.4.2 The supplier of analysis services shall verify that the labels are installed on the correct equipment and shall provide a verification report stating same.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 The section describes the installation requirements for installing cables in outdoor underground ducts and trenches.

1.1.2 These requirements apply to ducts and trenches for power, communications and control cables.

1.1.3 Installation of cables in indoor conduits and raceways is described in 16133 – Conduits, Conduit Fastenings and Fittings.

1.1.4 Installation of cables in cable tray is described in Section 16122 – Wires and Cables 0-1000V.

1.2 Related Sections

1.2.1 Division 1 – General Requirements All Sections

1.2.2 Section 02315 – Excavating, Trenching and Backfilling

1.2.3 Section 16010 – Electrical General Requirements

1.2.4 Section 16122 – Wires and Cables 0-1000V

1.2.5 Section 16133 – Conduits, Conduit Fastenings and Fittings

1.3 Submittals

1.3.1 Cable and Duct Log Book:

.1 Maintain a cable and duct log book on site.

.2 Record results of duct testing, cable pull tensions.

.3 Submit one (1) copy to the Contract Administrator on conclusion of job.

2 PRODUCTS

2.1 Cable Protection For 600 Volts

2.1.1 Use 38 x 140mm planks, pressured treated.

2.2 Markers

2.2.1 Concrete type cable markers: 600 x 600 x 100mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

2.3 Warning/Tracer Tape

2.3.1 Metal-detectable, heavy-duty polyethylene warning tape.

2.3.2 Width: 75 mm minimum

2.3.3 Tapes shall be the specified colour and shall contain approximately the following message:

.1 Power & composite duct banks: red tape with the warning “Caution – Electric Line”.

.2 Communications duct banks: orange tape with the warning “Caution – Telephone” or “Caution – Fibre Optic”.

2.4 Materials for direct-buried Duct Banks

2.4.1 Ducts shall be PVC Electrical Conduit, Type DB2, to CSA C22.2 No. 211.1

2.5 Materials for concrete-encased Duct Banks

2.5.1 Reinforcing steel to CSA G30.18 billet steel grade 400 deformed bars. All reinforcing rods shall have a minimum length of 1800mm and be overlapped by a minimum of 610mm.

2.5.2 Wire ties to CSA G30.0-M1983 plain, cold drawn annealed steel, to be used on rebar only.

2.5.3 Concrete to be 25.0 MPa, shall have a minimum slump of 100mm to 150mm and be of 12 mm gravel aggregate.

2.5.4 Ducts to be joined together with an approved coupling.

2.5.5 Ducts shall be PVC Electrical Duct, Type DB2/ES2, to CSA C22.2 No. 211.1.

2.5.6 Duct spacers shall be plastic, with dimensions as shown on the drawings or in accordance with OESC table B4-4.

.1 Approved product: IPEX Monobloc or equivalent.

.2 Wood spacers are not permitted

2.6 Cable Pulling equipment

2.6.1 All cable pullers capable of exerting a force in excess of 1500 kg shall have a force readout.

2.7 Pulling Lubricant

2.7.1 Use CSA approved pulling lubricant for all cable pulls into duct.

2.7.2 Lubricant shall be approved by the cable manufacturer and suitable to the specific installation.

2.7.3 Approved Manufacturer: American Polywater or Agency Approved Equal.

2.8 Splice Kits

2.8.1 Use cold-shrink splice kits for medium voltage cables.

3 EXECUTION

3.1 Excavation - General

3.1.1 Refer to section 02315 - Excavation Trenching and Backfill.

3.1.2 All trenching to be backfilled with granular 'B' material and compacted to 95% STD Proctor. All trenching to be restored to original condition.

3.1.3 Contractor shall stake all proposed electrical trenching and shall obtain approval from the Engineer prior to proceeding with trenching.

3.1.4 Coordinate installation of all buried conduit and ducts with civil works being installed below grade.

3.1.5 Contractor shall obtain service clearance for existing underground installations prior to trenching.

3.1.6 Supply, place, and maintain sheeting, bracing and shoring as required to support sides of excavations to prevent movement which can reduce necessary widths of excavations or otherwise injure or delay work, or endanger any person.

3.1.7 Contractor shall be responsible for protection of excavations where required to prevent adverse effects of rain or any other weather conditions on exposed excavations.

3.1.8 Contractor shall be responsible for dewatering of all excavations.

3.1.9 Excavation in close proximity to existing services which are to remain shall be made by hand.

3.1.10 Contractor shall be responsible for the repair and cost of all repairs to services damaged during construction in particular during excavation.

3.1.11 The position of pole lines, conduits, sewers, watermains, and other underground and above ground utilities is not necessarily shown on contract drawings and where shown, the accuracy of the position of such utilities and structures is not guaranteed. Before starting work, the contractor shall inform themselves of the exact location of all such utilities and structures and shall assume all liability for any damage done to them.

3.1.12 Contractor is responsible for the temporary support and /or relocation of existing utilities during construction. The contractor shall coordinate and comply with the requirements of all utilities when crossing or working near their services.

3.1.13 Contractor is responsible for the support of Hydro, Bell, Gas, and other utility poles and underground services affected by construction activities.

3.1.14 All conduit routes not shown shall be finalized and determined on site at no extra cost to the owner.

3.1.15 Seal all below grade duct entry with a hydrostatic electrical duct sealant product rated for 6.7m of water head pressure and up to 27 m surges.

3.2 Direct Buried Ducts

3.2.1 The duct lengths shall be joined together with and approved coupling and solvent to provide a sound and watertight joint. The joints in adjacent ducts shall be staggered by at least 200mm.

3.2.2 Deburr all ends prior to assembling joints.

3.2.3 When complete, the ducts shall be clean, waterproof and free from obstructions and the ends plugged with standard plastic duct plugs to prevent the ingress of moisture and dirt.

3.2.4 A non-metallic, non-deteriorating rope with a minimum five hundred (500) pounds breaking strength shall be installed in each duct.

3.2.5 All ducts to be terminated at both ends with a “Bell End” coupling.

3.2.6 The duct shall have an even slope in one (1) direction of not less than 75 mm in 30.5 meters to provide drainage. The slope should be toward the street where possible.

3.2.7 Backfill the remaining trench with selected excavated materials per section 02315 except:

.1 Backfill with sand to 100 mm above the top of the ductbank.

.2 Compact the next 300 mm of backfill material by hand.

3.3 Concrete Encased Ducts

3.3.1 Concrete encased ducts to be installed with a minimum of 1000mm cover (below finished grade) unless otherwise noted.

3.3.2 Concrete encased duct bank shall be constructed on undisturbed soil or on well compacted granular ‘A’ material not less than 150 mm thick, compacted to 95% of corrected maximum dry density.

3.3.3 Install spacers in accordance with manufacturer’s instructions.

3.3.4 Adjacent couplings shall be staggered by at least 200mm.

3.3.5 Deburr all ends prior to assembling joints.

3.3.6 When complete, the ducts shall be clean, waterproof and free from obstructions and the ends plugged with standard plastic duct plugs to prevent the ingress of moisture and dirt.

3.3.7 The duct run shall be reinforced. Reinforcing steel bars 16 mm diameter shall be laid longitudinally along the trench with 100 mm lateral spacing and 50 mm above the base of the concrete.

.1 An overlap of 610 mm on the reinforcing bars shall be provided where necessary. The duct runs shall also be reinforced at all building and manhole entries with the bars being embedded in the walls.

.2 Reinforcing bars shall be placed 50 mm inside the perimeter of the bank at 100mm centres along the sides and bottom of the bank. The rods shall project 900 mm from the centre to anchor firmly into the concrete of the extension when the latter is poured.

3.3.8 Where concrete formwork is required, construct in accordance with CAN3-A23.1-M77.

.1 Formwork lumber materials to CAN3-A23.1-M77.

3.3.9 Do not pour concrete directly onto the ductbank structure. Concrete shall be deflected down alongside the ducts to the bottom and up through the duct assembly.

3.3.10 Where shown on the drawings, lay a bare copper conductor in the ductbank with 50 mm of concrete cover. Bring either end of conductor out and terminate.

3.3.11 The concrete shall be worked below and between pipes to produce a homogeneous mass.

3.3.12 Clearances:

.1 At crossings with other utilities, maintain a minimum 300 mm vertical clearance.

.2 When running parallel to another utility the duct bank, maintain a minimum horizontal clearance of 1.5 m.

3.3.13 The Contractor shall notify the Contract Administrator at least twenty four (24) hours before concrete is poured to permit inspection of duct installation.

3.3.14 Backfilling of trenches shall not commence until concrete has attained 50% of its strength.

3.3.15 Where it is required that the proposed ducts shall join directly with the Hydro's ducts, the proposed ducts shall be left projecting (minimum 300 mm) from their concrete envelope in a staggered pattern. They shall be equipped with suitable couplings and plugged until the joints are made. The face of the concrete envelope shall be left rough to key with the extension envelope and 16mm diameter steel reinforcing bars 1.8 m in length shall be encased longitudinally in the envelope.

3.4 Direct Burial of Cables

3.4.1 After sand bed specified in Section 02315 – Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

3.4.2 Provide offsets for thermal action and minor earth movements. Offset cables 150mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

3.4.3 Minimum permitted radius at cable bends for rubber or plastic covered cables, eight (8) times diameter of cable; for metallic armoured cables, twelve (12) times diameter of cables or in accordance with manufacturer's instructions.

3.4.4 Cable separation:

.1 Maintain a minimum of 75 mm separation between cables of different circuits.

.2 Maintain a minimum of 300 mm horizontal separation between low and high voltage cables.

.3 When low voltage cables cross high voltage cables maintain a minimum of 300 mm vertical separation with low voltage cables in upper position.

.4 At crossover, maintain a minimum of 75 mm vertical separation between low voltage cables and 150 mm between high voltage cables.

.5 Maintain a minimum of 300 mm lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.

.6 Install treated planks on lower cables 0.6 m in each direction at crossings.

3.4.5 Backfill the remaining trench with selected excavated materials per section 02315 except:

.1 Backfill with sand to 100 mm above the top of the ductbank.

.2 Compact the next 300 mm of backfill material by hand.

.3 Install a continuous row of overlapping 38 mm x 140mm pressure treated planks where indicated to cover length of run.

3.5 Cable Installation in Ducts

3.5.1 Install cables as indicated in ducts.

3.5.2 Do not pull spliced cables inside ducts.

3.5.3 Install multiple cables in duct simultaneously.

3.5.4 Submit to the Engineer prior to cable installation calculations that indicate the maximum pulling tension of the cable will not be exceeded. Do not exceed cable pulling tensions and bending radius recommended by manufacturer.

3.5.5 Preparation

.1 Inform the Contract Administrator three (3) days prior to the inspection. Conduct tests in the presence of the Contract Administrator.

.2 Pull a rubber swab and wire brush through the conduit prior to pulling in the pulling cable.

.3 Pull a slug with diameter of 80% of the conduit ID through the entire length of duct that the cable will be installed in.

.4 Record the date and time of inspection and the condition of the mandrel in a log book.

.5 Submit copies of the logbook to the Contract Administrator upon completion of cable pulling.

.6 Pull cables immediately upon successful testing.

3.5.6 For cable pulls exceeding 1200 kg and/or 75% of the allowable cable pulling tension or sidewall bearing pressure, use cable puller with a force gauge.

.1 Record the maximum pulling force in a log book.

.2 Record dynamometer correction factors as applicable.

3.5.7 Take all measures to reduce pulling tension and damage to the cables, including but not limited to: lubricants, sleeves, shoes, etc.

3.5.8 Cables shall be guided into ducts and shall not rub the edge of the conduit opening.

3.5.9 Cables showing signs of jacket damage shall be removed and replaced.

3.5.10 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

3.5.11 Before pulling cable into ducts and until cables are properly terminated, seal cables end with moisture seal tape or cold-shrink caps.

.1 Cold shrink caps shall be the only sealing method for medium-voltage cables.

3.5.12 After installation of cables, seal duct ends with approved, water tight duct sealing compound.

3.6 Splicing of cables

3.6.1 Splices are permitted only in pull pits, vaults or chambers.

.1 Underground cable splices not acceptable.

3.6.2 Make termination and splice only as indicated leaving 0.6m of surplus cable in each direction.

.1 Make splices and terminations in accordance with manufacturer's instructions using approved splicing kits.

3.7 Restoration

3.7.1 All landscaping to be restored to its original condition.

3.7.2 Install detectable warning tape within 150 mm of the final grade.

3.7.3 Provide all required asphalt and/or concrete cutting for installation of the proposed high voltage duct bank. All surfaces to be restored to new conditions once work complete.

3.7.4 Install cable markers in asphalt or concrete surfaces.

.1 Mark cable every 50 m along cable runs and changes in direction.

.2 Use concrete type markers.

3.7.5 Where markers are removed to permit installation of additional cables, reinstall existing markers.

3.8 Field Quality Control

3.8.1 Test cables in accordance with the requirements of the relevant cable specification section.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section describes the requirements for the installation of the primary grounding and bonding requirements.

1.2 References

1.2.1 ANSI/IEEE 837-1988, Qualifying Permanent Connections used in Substation Grounding

1.2.2 CSA C22.2 No. 41 (latest edition) Grounding and Bonding Equipment

1.2.3 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).

.1 ANSI/IEEE 837-14 or latest edition, Qualifying Permanent Connections Used in Substation Grounding

.2 IEEE No. 80, IEEE Guide for Safety in AC Substation Grounding

2 PRODUCTS

2.1 Equipment

2.1.1 Rod electrodes: copper clad steel, 19 mm diameter by minimum 3 m long.

2.1.2 Plate electrode: copper, minimum surface area 0.2 m2, 6.4 mm thick.

2.1.3 Conductors: bare, stranded, soft annealed copper wire, size No. 4/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

2.1.4 Conductors: PVC insulated coloured green, stranded soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.

2.1.5 Conductors: PVC insulated coloured green, stranded soft annealed copper wire No. 10 AWG for grounding meter and relay cases.

2.1.6 Conductors: No. 3/0 AWG extra flexible (425 strands) copper conductor for connection of switch mechanism operating rod to gradient control mat, fence gates, vault doors.

2.1.7 Bolted removable test links.

2.1.8 Gradient control mat: Copper, size as indicated on the contract drawings.

2.1.9 Main ground Bar: 98% conductivity copper strip having cross-section of 25 mm x 6 mm. Provide 2 mechanical bonding connectors and conductors for connection to the main ground bus bar, unless noted otherwise.

2.1.10 Accessories: non-corroding, necessary for complete grounding system, type, size material as needed/indicated on the contract drawings, including:

.1 Grounding and bonding bushings

.2 Protective type clamps

.3 Bolted type conductor connectors

.4 Thermit welded type conductor connectors

.5 Bonding jumpers, straps

.6 Pressure wire connectors

2.1.11 Wire connectors and terminations: as needed/indicated on the contract drawings.

2.1.12 Cable sheath isolating sleeves.

3 EXECUTION

3.1 Equipment

3.1.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with the manufacturer's written instructions.

3.1.2 Visually inspect substrate in presence of the Consultant.

3.1.3 Inform Consultant, in writing, of unacceptable conditions immediately upon discovery.

3.1.4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 Installation General

3.2.1 Install continuous grounding and bonding system including electrodes, conductors, connectors and accessories as indicated on the contract drawing and to requirements of Electrical Safety Authority (ESA) and Alectra Utilities.

3.2.2 Ground fences and/or bollards to grounding system independent of station ground.

3.2.3 Install connectors and cad weld in accordance with manufacturer's instructions.

3.2.4 Protect exposed grounding conductors during and after construction.

3.2.5 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process or permanent mechanical connectors to ANSI/IEEE 837.

3.2.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

3.2.7 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG mhd (medium hard drawn) bare copper cable for taps on risers from main ground bus to equipment.

3.2.8 Use tinned copper conductors for aluminum structures.

3.2.9 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.3 Electrodes

3.3.1 Install ground rod / plate electrodes. Make grounding connections to station equipment.

3.3.2 Install ground rod electrodes at transformer and switchgear locations.

3.3.3 Install gradient control mats. Connect mats to station ground electrode and switch mechanism operating rods.

3.3.4 The grounding resistance of the system not to exceed five (5) ohms for low voltage system, and one (1) ohm for high voltage system.

3.3.5 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

3.4 Equipment Grounding

3.4.1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral, gradient control mats. Noncurrent carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cut-out bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies. Outdoor lighting.

3.4.2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

3.4.3 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station. Make connections to metallic water pipes outside station to assist in reduction of station ground resistance value.

3.5 Equipment Bonding

3.5.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.5.2 Install bonding connections between distribution components and equipment in accordance with code requirements including but not limited to, primary distribution system switchgear, auxiliary MCC, distribution panel boards, transformers, packaged equipment, motor frames/housing., control panels.

3.6 Neutral Grounding

3.6.1 Connect transformer neutral and distribution neutral together using 1000 V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main building/plant ground.

3.6.2 Interconnect electrodes and neutrals at each grounding installation.

3.6.3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.

3.6.4 Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

3.7 Grounding in Manholes

3.7.1 Install conveniently located grounding stud, electrode, and size No. 4/0 AWG stranded copper conductor in each manhole.

3.7.2 Install ground rod with lug for grounding connection in each manhole so that top projects through bottom of manhole.

3.8 Cable Sheath Grounding

3.8.1 Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.

3.8.2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.

3.8.3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.9 Field Quality Control

3.9.1 Perform tests in accordance with Section 16010 – Electrical General Requirements.

3.9.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Contract Administrator and the local authority having jurisdiction over installation.

3.9.3 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfilling.

3.9.4 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval the Consultant, Electrical Safety Authority (ESA).

3.9.5 Perform test before energizing electrical system.

3.9.6 Submit test result and inspection certificate before energizing electrical system to the Consultant / Contract Administrator.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section describes the requirements for the new building ground and general grounding and bonding requirements.

1.2 Scope

1.2.1 Provide a complete grounding system for the new electrical distribution, including panel boards, transformers, and all equipment supplied by the distribution system.

1.2.2 Provide new dedicated copper ground electrodes and/or ground bar/bus for the electrical equipment as shown on the drawings.

1.2.3 Provide bonding conductors for all electrical equipment. Unless otherwise indicated, provide a dedicated bond conductor to each piece of equipment, sized in accordance with Ontario Electrical Safety Code, 2024 Edition.

1.2.4 Bond all non-current carrying metallic equipment including metallic piping, raceways and tray and building steel to ground.

1.2.5 Provide a dedicated ground/bond conductor to suit each directly buried cable, and/or metallic raceway power distribution application sized in accordance with the Ontario Electrical Safety Code. Ground conductor to be buried adjacent to the current carrying conductors.

1.3 References

1.3.1 ANSI/IEEE 837-1988, Qualifying Permanent Connections used in Substation Grounding.

1.3.2 IEEE Standard 142™-1991 IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

1.3.3 IEEE 81.2-1991 IEEE Guide for Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems.

2 PRODUCTS

2.1 Equipment

2.1.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

2.1.2 Copper conductor: minimum 3 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

2.1.3 Rod electrodes: copper clad steel 19mm diameter, by 3m long.

2.1.4 Grounding conductors: bare stranded copper, tinned, soft annealed size as indicated.

2.1.5 Insulated grounding conductors: green, size: #4/0 AWG.

2.1.6 Ground bus: copper bus with insulated supports, complete with fastenings, connectors.

2.1.7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Compression-type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

3 EXECUTION

3.1 Installation General

3.1.1 Install complete permanent, continuous grounding system including electrodes, conductors, connectors, accessories. Where a metal duct, conduit or raceway is used, run a dedicated ground wire in conduit.

3.1.2 Install connectors in accordance with manufacturer's instructions.

3.1.3 Provide a dedicated bonding conductor in all metallic and non-metallic raceways.

3.1.4 Protect exposed grounding conductors from mechanical injury.

3.1.5 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

3.1.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

3.1.7 Soldered joints are not permitted to suit ground connections.

3.1.8 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solder-less lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

3.1.9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

3.1.10 Install separate ground conductor to outdoor lighting standards.

3.1.11 Connect building structural steel and metal siding to ground by welding copper to steel.

3.1.12 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.1.13 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.1.14 Ground secondary service pedestals.

3.2 Electrodes

3.2.1 Install rod and make grounding connections as noted on the drawingsBond separate, multiple electrodes together.

3.2.2 Unless otherwise stated, use size #6 AWG copper conductors for connections to electrodes.

3.2.3 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.3 System and Circuit Grounding

3.3.1 Install system and circuit grounding connections to neutral of primary 27.6kV & 600V systems and secondary 120/208V system.

3.4 Equipment Bonding

3.4.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.4.2 Install bonding connections between distribution components and equipment in accordance with code requirements including but not limited to, primary distribution system switchgear, auxiliary MCC, distribution panel boards, transformers, packaged equipment, motor frames/housing., control panels.

3.5 Field Quality Control

3.5.1 Perform tests in accordance with Section 16010 – Electrical General Requirements.

3.5.2 Perform ground continuity and resistance tests using methods appropriate to site conditions and to approval of the Contract Administrator and the local authority having jurisdiction over installation.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 The section describes the identification requirements for electrical equipment including distribution equipment, wire and conduit and loads.

1.1.2 Process equipment identification requirements and requirements for client asset management tagging are found elsewhere.

1.2 Scope

1.2.1 Provide identification nameplates for all electrical apparatus including switchgear, distribution panels, motor starters, transformers, disconnect switches, conduit, wiring, junction boxes, breakers, contactors, system control panels, telephone panels, etc

1.2.2 Provide conduit markers for all surface mount raceway and cable tray applications at every 50 ft.

1.2.3 All power and systems wiring shall be colour coded in accordance with this Section and be provided with appropriate wire markers identifying panel circuits.

1.2.4 Provide heat shrink wire labels all control & communication wiring applications. In addition, provide clip-on wire markers in accordance with this section.

1.3 General

1.3.1 Nameplates for outdoor locations shall be UV resistant.

1.3.2 Nameplates shall be oil and water resistant.

1.3.3 All materials shall be suitable for the temperatures and contaminants present in the area the equipment is located in.

.1 Refer to the equipment specifications and drawings for the environmental conditions for each equipment.

1.3.4 All adhesives shall be designed to adhere permanently to the equipment.

1.3.5 Unless otherwise indicated, allow for average of 25 letters per nameplate.

1.3.6 Identification to be English.

1.4 Submittals

1.4.1 Provide samples of all nameplate materials.

1.4.2 Provide data sheets for all adhesive labels indicating the following:

.1 Dimensions and colours

.2 Suitable substrates

.3 Resistance to contaminants and environmental conditions

.4 Application requirements

1.4.3 Issue nameplates lists for review prior to manufacture

.1 The final wording of all nameplates shall be reviewed and approved by the Owner and Consultant prior to fabrication.

2 PRODUCTS

2.1 Lamicoid Nameplates

2.1.1 All identification nameplates and nametags unless otherwise specified shall be engraved black letters on white Lamicoid stock with bevelled edges. The Lamicoid stock shall be 3 mm minimum thickness.

2.1.2 For equipment in dry, indoor areas, lamicoid nameplates shall be drilled for mechanical attachment

2.1.3 In wet, outdoor and/or classified locations provide lamicoid nameplates with pressure-sensitive adhesive suitable for the material and environment.

2.1.4 Where equipment surfaces prevent mechanical or adhesive fastening, mount lamicoid nameplates with stainless steel chains

.1 In classified areas, provide non-sparking chains.

2.2 Adhesive Tape Nameplates

2.2.1 Where tape nameplates are specified or indicated, provide oil and water resistant nameplates with an adhesive suitable for the equipment surface and the environmental conditions.

2.3 Power and Teck90 Cable Tray Lamicoids

2.3.1 Each Power Cable tray to be provided with a Lamicoid Label indicating, the power cables that are populated in the respective Cable Tray. Provide a minimum 400mm x 400mm limacoid with a list of cables indicating MCC / Switchgear origin and equipment tag. Limacoid labels to be applied every 50 ft in tray.

2.3.2 Each TECK cable in tray is to be provided with a Lamicoid Label indicating, the power cables that are populated in the respective Cable Tray. Provide a minimum 400mm x 400mm limacoid with a list of cables indicating equipment tag origin and destination, example: MCC-0001 to TX-0001. Provide a minimum 400mm x 400mm limacoid with a list of cables indicating MCC / Switchgear origin and equipment tag. Limacoid labels to be applied every 50 ft in tray

2.4 Conduit and Cable Lamicoid Markers

2.4.1 Provide wall mounted conduit marker legend to identify color coding.

2.4.2 Markers to be pressure-sensitive, coloured, vinyl pipe banding tape. The markers are to consist of 38 mm diameter circular lamicoid coloured tags, strapped to the respective raceway every 8 to 10 meters with wall mounted legends in each area.

2.4.3 Provide conduit lamicoid markers for all surface mount raceway applications as well as armoured cables, including in cable trays, at every 50 ft with color coded markers described below.

Voltage	**Prime**	**Auxillary**
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	Red
Telephone Fiber Communication CAT6 Communication	Green Green Green	 Blue Red
Other communication	Green	Black
Fire alarm	Red	
Emergency voice	Red	Blue
Other security systems	Red	Yellow
DC	Red	Black

2.5 Wire Labels (Controls/Communication Wiring)

2.5.1 Provide pre-printed, permanent, heat-shrink, labels for wires less than #1 AWG.

.1 Colour: Black letters on white body unless otherwise indicated.

2.5.2 Provide cable markers for all wires #1 AWG and larger.

2.5.3 All wire markers shall be fire retardant.

2.5.4 Acceptable Products:

.1 Brady Perma-sleeve

.2 Panduit Military Grade Heat Shrink Labels

.3 Approved equivalent

2.6 Wire/Cable Markers

2.6.1 Provide pre-printed, plastic, clip-on wire markers.

.1 Colour: Black letters on white body

2.6.2 Acceptable products:

.1 Thomas & Betts type SM markers

.2 Approved equivalent

2.7 Phasing Tape

2.7.1 Coloured polyvinyl chloride (PVC) electrical tape with pressure-sensitive adhesive.

2.7.2 The tape shall be 7 mils thick (min)

2.7.3 The tape shall meet CSA C22.2 No.197 and shall be marked as “Flame-Retardant.”

2.7.4 The tape shall be compatible with synthetic cable insulations, jackets and splicing compounds.

2.7.5 Continuous operating temperature: 105 °C (min)

2.7.6 Voltage Rating: 600 V (min)

2.8 Distribution Equipment – General

2.8.1 Engrave nameplates for switchgear, switchboards, distribution panels, MCCs splitters and other distribution equipment as follows:

.1 First line: Equipment Name per single line in 25 mm high lettering

.2 Second line: Voltage in 13 mm high letters

.3 Third line: Power Source in 8 mm high letters

.4 Example:

.1 MCC-XX

.2 600 V

.3 Fed from MCC-XX

2.9 Lighting Panels and Splitters

2.9.1 Engrave nameplates for lighting panels and splitters as follows:

.1 First line: Equipment Name per single line in 13mm high lettering

.2 Second line: Voltage in 8 mm high letters

.3 Third Line: Source in 8 mm high letters

.4 Example:

.1 LP-A

.2 120/208 V

.3 Fed from Transformer TX-##

2.10 Loads

2.10.1 Engrave nameplates for all loads as follows:

.1 Equipment description per the single line diagram in 13 mm high letters

.2 Equipment number per the single line diagram in 13 mm high letters

.3 Voltage in 8 mm high letters

.4 Fourth Line: Power Source in 8 mm high letters

.5 Example:

.1 High Lift Pump 1

.2 HLPXXXX

.3 600 V

.4 Fed from MCC-XX

.6 Comply with the owner's equipment identification requirements.

2.11 Junction boxes, Terminal Cabinets, Pull Boxes, etc.

2.11.1 Terminal cabinets and pull boxes: indicate equipment being controlled and its voltage

2.11.2 Nameplates for junction boxes, terminal boxes, pull boxes, etc. larger than a 100mm square to indicate system voltage characteristics.

2.11.3 Engrave nameplates for all loads as follows:

.1 Equipment description per the single line diagram in 13 mm high letters

.2 Equipment number per the single line diagram in 13 mm high letters

.3 Voltage in 8 mm high letters

.4 Fourth Line: Power Source in 8 mm high letters

.5 Example:

.1 Low Lift Pump Discharge Valve

.2 FVXXXXX

.3 600 V

.4 Fed from MCC-XX

.6 Comply with the owner's equipment identification requirements.

2.12 Transformers

2.12.1 Engrave nameplates for all transformers as follows:

.1 Equipment description per the single line diagram in 25 mm high letters

.2 Primary and Secondary voltage in 13 mm high letters

.3 Third Line: Power Source

.4 Example:

.1 TR-1

.2 600-208/120 V

.3 Fed from MCC-XX

2.13 Warning Signs

2.13.1 Provide warning signs as specified or to meet requirements of the Electrical Safety Authority (ESA) and Engineer.

2.13.2 Unless otherwise specified, signs shall comply with CAN/CSA-Z321-96 Signs and Symbols for the workplace.

2.13.3 Decal signs, minimum sized 175 mm x 50 mm.

2.13.4 Protect exposed live equipment during construction for personnel safety.

2.13.5 Shield and mark live parts "LIVE 600 VOLTS", or with appropriate voltage in English.

3 EXECUTION

3.1 General

3.1.1 Plates shall be installed after all painting has been completed.

3.2 Lamicoid Nameplates

3.2.1 Lamicoid nameplates shall be mounted behind the panel door, mechanically fastened or secured with contact cement.

3.2.2 Attach mechanically-fastened lamicoid nametags with self-tapping screws.

.1 Use rivets and nut & bolts where access may conflict with a protruding screw point.

3.3 Adhesive Labels

3.3.1 Clean all surfaces in accordance with manufacturer's recommended procedure prior to applying adhesive nameplates.

3.3.2 Do not apply adhesive labels when the temperature is outside the manufacturer's recommended range.

3.3.3 Feeder cables shall be colour coded in each terminal panel and junction box with phasing tape.

3.4 Wiring Identification

3.4.1 Identify wiring at both ends and at all points that the conductors is accessible (i.e. distribution panels, MCC, junction boxes, elbows, etc.)

3.4.2 Identify each control conductor in accordance with the Owner Standards.

3.4.3 Identify all power conductors according to the application and/or circuit number.

3.4.4 Identify spare wiring with unique tag number and record on record drawings.

3.4.5 Wiring identification shall match the drawings.

3.4.6 Apply phasing tape where the wire jacket does not indicate phase.

3.5 Conduit and Armoured Cable Identification

3.5.1 Apply conduit marking tape at points where conduit or cable enters equipment, walls, ceilings, or floors, and at 10m intervals.

3.6 Manufacturers and CSA Labels

3.6.1 Visible and legible after equipment is installed

END OF SECTION

1 GENERAL

1.1 Summary

1.1.1 Comply with Division 1 – General Requirements and Section 16010 – General Electrical Requirements.

1.1.2 Provide all new cable trays to suit the requirements of the power distribution and controls applications identified on the drawings.

1.1.3 Not all cable tray applications are identified on the drawings. The Contractor is required to provide additional cable trays in accordance with the requirements of the distribution power feeders identified on single line diagrams and control wiring drawings.

1.1.4 The cable tray layout & details shown on the drawings is a proposed installation only. Contractor may adjust the layout as required with approval from Engineer.

1.1.5 As part of shop drawings, Contractor shall provide a cable tray routing plan for installation of new cable trays in the tunnels. The routing plan must also include installation of new cables in existing cable trays.

1.1.6 Provide ventilated covers for all new cable trays.

1.1.7 Unless indicated otherwise, provide cable tray to suit all Teck90 power conductors.

1.2 Related Sections

1.2.1 Section 01330 – Submittals

1.2.2 Section 16010 – General Electrical Requirements

1.3 References

1.3.1 CSA C22.2 No. 126 Cable Tray Systems.

1.4 Design Requirements

1.4.1 CSA Class C1 load carrying capability, ladder, aluminum, 75mm minimum side rail height, width to suit the design drawings.

1.4.2 All installation and mounting hardware shall be stainless steel.

1.4.3 All cable tray dimensions shown on the drawings are minimum requirements. The contractor is required to increase the cable tray dimensions as required to ensure that all single conductor installations maintain a free air ampacity rating in accordance with the Ontario Electrical Safety Code, 2024 Edition. Alternatively, the Contractor may install cables on top of another to maintain the minimum spacing for free air rating.

1.4.4 Provide support and cable tray loading calculations at the request of the engineer.

1.5 Site Conditions

1.5.1 Provide cable tray applications in accordance with the single line diagram and building power distribution layout drawings. The Contractor is required to verify the building conditions and locations of new and existing building services that may be in the path of the proposed cable tray installations.

1.5.2 The Contractor is responsible for obtaining all measurements and clearances to suit the design and installation of the new cable tray.

1.5.3 The Contractor is required to confirm the locations of other building services that may conflict with the installation of the cable tray and adjust the routing to suit.

1.6 Product Data

1.6.1 Submit shop drawings in accordance with Section 01330 – Submittal Procedures.

1.6.2 Drawings to include individual product sheets for each type of cable tray section, quantity, and dimensions.

1.7 Submittals

1.7.1 A detailed submittal package identifying the equipment to be supplied shall be furnished.

1.7.2 The submittal package shall identify all cable tray components to be installed to suit the specific cable tray applications.

1.7.3 Provide a drawing for each application that identifies the cable tray routing for each, including horizontal and vertical bends and transitions.

2 PRODUCTS

2.1 Materials

2.1.1 Acceptable cable tray manufacturers:

.1 Thomas & Betts

.2 Eaton/Cooper B-Line

.3 Or, Agency Approved Equal

2.1.2 Ladder type cable tray: 300mm rung spacing.

2.1.3 Barriers: Solid metal, of same material as cable tray.

2.1.4 Fitting bending radius: 600mm minimum, except that minimum bending radius for trays supporting high voltage cables (above 3000V) is as required by Inspection Authority, unless otherwise indicated.

2.1.5 Anchors: Type HKD by Hilti (Canada) Ltd., type Redhead Multi-set II Anchors by Phillips.

2.1.6 Hanger rods and hardware to be stainless steel 12mm minimum diameter.

2.1.7 Cable trays shall be aluminium. All mounting hardware to be stainless steel.

3 EXECUTION

3.1 Installation

3.1.1 Provide cable tray raceway systems as indicated with fittings, accessories and hangers required.

3.1.2 Do not suspend or support the cable tray from existing building services or service equipment. All cable trays are to be supported from the building structure.

3.1.3 Install cable tray and duct runs to avoid interferences with process or service equipment, piping and ducting. Install trays and ducts parallel to building lines and conserve headroom.

3.1.4 Coordinate location of supports and runs with other trades.

3.1.5 Space tray supports 1200 mm maximum, and duct supports 1500 mm maximum. Mechanically bolt tray connections. Install supports within 300 mm of either side of bends and T fittings.

3.1.6 Provide support system adequate to accommodate stresses imposed by cable pulling.

3.1.7 Provide additional hardware including reducers, expansion plates, bonding jumpers etc. as required.

3.1.8 Allow for unobstructed clamping of cables or conduits in cable trays.

3.1.9 Close off dead ends of cable tray and duct with fittings recommended by manufacturer.

3.1.10 Install tray and duct systems continuous through walls and floors.

3.1.11 Provide vertical tray sections with removable solid covers to 3000 mm minimum from finished floor level.

3.1.12 After installation of trays and cables, seal openings in walls and floors to original fire rating with fire resistant material.

3.1.13 Anchor support system to concrete, concrete block and other masonry surfaces. Do not drill into concrete beams without written authorization from Engineer. Do not crack masonry surface when drilling.

3.1.14 Fasten support systems to structural steel with beam clamps. Do not weld, drill or cut structural steel without written authorization from Engineer.

3.1.15 Fasten vertical cable trays terminating at equipment enclosure to top of enclosure.

3.1.16 Provide expansion joint type coupling connectors and bonding jumpers at building expansion joints and on straight runs exceeding 30 m.

3.1.17 Install a bare copper conductor in each tray for equipment grounding. Comply with Inspection Authority requirements. Attach ground conductor to each tray section and fitting with an accepted ground clamp. Alternatively, connect tray sections and fittings together utilizing a mechanical bonding method acceptable to Inspection Authority.

3.1.18 Bond trays and ducts to building grounding system at 5m maximum intervals and at ends in accordance OESC section 12 “Provisions for bonding” for applicable cable types. For interlocking metal armoured cable applications provide permanent warning notice with wording “INTERLOCKING METAL ARMOUR CABLES OR CONTINUOUS METAL SHEATH CABLES ONLY”, placed in a conspicuous position on the tray, with the maximum spacing of warning notices not to exceed 5 m based on the use of 3 ply engraved plastic lamacoid labels with 25mm high text, with Red/White contrasting colour.

3.1.19 Review all clearance requirements identified on the drawings as well as those required by OESC (Ontario Electrical Safety Code) and ensure that cable tray installation meets all the required clearances.

3.1.20 Touch-up field cut steel trays and ducts with zinc rich galvanizing primer. Remove burrs and uneven edges.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section describes the requirements for wire and cable up to 1000V for power, control and communications circuits.

1.1.2 This section does not apply to special-application wiring such as festoon cables, wiring provided by manufacturers to run between parts of packaged systems, or to wiring inside equipment and panels. Refer to the individual equipment specifications.

1.2 General

1.2.1 All necessary power and control wiring to all equipment shall be supplied and installed to suit the power and control requirements noted on the drawings. It shall be noted that the drawings do not necessarily indicate the locations of each individual feeder, but these shall be located to best suit the site conditions.

1.2.2 Where cable constructions are shown on drawings, the drawings shall take precedence.

1.2.3 All cables to be sized and installed in accordance with the OESC, 2024 edition.

1.2.4 All conductors shall be stranded copper unless otherwise noted.

1.2.5 All exposed wiring should have flame test rating FT4 unless otherwise indicated.

.1 All wiring in plenums including areas above drop ceilings acting as plenums shall have flame test rating FT6.

1.2.6 Wire and cable for all applications shall meet the equipment supplier's requirements and the OESC. Where this section does not contain specific requirements, refer to the manufacturer's instructions and the OESC.

1.3 Related Sections

1.3.1 Section 13100 – Controls & Instrumentation

1.4 References

1.4.1 CSA C22.2 No.0.3-92, Test Methods for Electrical Wires and Cables.

1.4.2 CSA - 600 V AWM I/II A/B – For VFD Applications

1.4.3 CSA C22.2 No. 131 Type TECK 90 Cables.

1.4.4 CSA C22.2 No. 38 Thermoset Insulated Wires and Cables.

1.4.5 CSA C22.2 No. 174 Cables and Cable Glands for use in Hazardous Locations.

1.4.6 CSA C22.2 #239 Control and Instrumentation Cable

1.4.7 ICEA S-66-524.

1.5 Submittals

1.5.1 Submit product data in accordance with Section 01330-Submittal Procedures.

1.5.2 Provide data sheets indicating the following:

.1 Manufacturer's name

.2 Cable type and ratings

.3 Approval listings

.4 Conductor, insulation, shield and jacket materials (as applicable)

.5 Temperature ratings for conductors and installation

.6 Weight/unit length

.7 Allowable pulling tension and sidewall bearing pressure

.8 Minimum bend radius

.9 Manufacturer's handling and installation requirements.

2 PRODUCTS

2.1 Colours

2.1.1 Colour Coding, three phase systems:

.1 Phase A – Red

.2 Phase B – Black

.3 Phase C – Blue

2.1.2 Colour Coding, single phase systems:

.1 Live – Black

.2 Neutral – White

2.1.3 Insulated ground wires: green.

2.1.4 Multi-conductor control cable: individual conductor colours per ICEA Method K-1.

2.2 Minimum Conductor Sizing

.1 The minimum conductor sizing shall be as follows:

.1 Motor or branch circuit feeders: 12 AWG.

.2 Remote DC emergency fixtures: 10 AWG.

.3 Digital control wiring, 24 to 120 VAC/VDC: 14 AWG

.4 Minimum current transformer wiring conductor: #10 AWG.

.5 Minimum fire alarm circuits conductor size: #14 AWG

.6 Minimum PA circuit conductor size: #16 AWG

.7 Telephone wiring conductors sized in accordance with telephone utility standards.

.8 Use #10 AWG minimum for home runs to lighting panels exceeding 25 m.

2.3 Identification

2.3.1 Identify all wiring with wire markers at both ends.

2.3.2 All branch circuit wiring and all systems wiring shall be identified at all panels and terminal boxes.

2.3.3 All wiring shall be identified at junction boxes and termination points.

2.4 Terminations

2.4.1 All wiring connections shall be made with T & B StaKon crimp connector, or approved equal, applied with a pressure tool.

2.4.2 Wiring connections, where required, shall be made with CSA approved compression tool with a nylon cap equal to Buchanan “Pres Sure”.

2.4.3 All wiring shall be sized so that voltage drop between the panel board and the furthest outlet shall not exceed 2% when the circuit has a full load.

2.5 Unarmoured Power Wire

2.5.1 System Description: 600 V solidly grounded, 120/208 and/or 120/240 solidly grounded power conductors.

2.5.2 Allowable Construction:

.1 Wire in conduits, above grade: 1/C, RW90

.2 Wire in conduit, underground and/or wet locations: 1/C, RWU90

.3 Wire to suspended lighting fixtures: 3/C, SWT90 or SWT105 to suit luminaire.

.4 Insulated ground wires for cable tray and above-ground, dry area conduit: 1/C, RW90

.5 Insulated ground wires, below grade conduits and wet areas: 1/C, RWU90

.6 All conductors copper unless otherwise noted.

2.5.3 Insulation: XLPE, 1000V, 90°C or 105°C as required.

2.5.4 Shielding: Non-shielded

2.5.5 Jacket: abrasion, oil and acid resistant.

2.5.6 cUL Flame test: FT4

2.5.7 Type RW90 and RWU90 construction shall meet CSA C22.2 No. 38.

2.5.8 Acceptable manufacturers: Prysmian, Nexans, Southwire, United Wire of Canada.

2.6 Armoured Power Wire and Cable

2.6.1 System Description: 600 V solidly grounded, 120/208 and/or 120/240 solidly grounded power conductors.

2.6.2 Environmental Conditions: damp indoor areas with temperatures ranging between -10 degree C and 40 degree C.

2.6.3 Shielding: Non-shielded cable unless otherwise noted.

2.6.4 Allowable Construction:

.1 Wire in tray in dry, damp or wet areas: TECK90, FT4

.2 Wire in classified areas: TECK 90, HL, FT4

.3 Direct buried wiring: TECK 90, -40 °C

.4 Concealed wiring in office areas: AC90

2.6.5 Insulation: XLPE, 1000 V, 90 °C (wet)

2.6.6 Shielding; none

2.6.7 Inner and outer jacket: moisture and oil resistant, low-acid gas, sunlight resistant,

.1 Outer jacket colour: black

2.6.8 Flame Spread Rating: FT4.

2.7 Digital Control Wire

2.7.1 System Description: field wiring, 24 to 120 V digital signals for control circuits when run in conduit

2.7.2 Allowable Construction

.1 Wire in conduits, above grade: 1/C RW90

.2 Wire in conduit, underground and/or wet locations: 1/C RWU90

2.7.3 Insulation: XLPE, 600V, 90°C

2.7.4 Shielding: Non-shielded

2.7.5 Jacket: abrasion, oil and acid resistant.

2.7.6 cUL Flame test: FT4

2.7.7 Type RW90 and RWU90 construction shall meet CSA C22.2 No. 38.

2.7.8 Acceptable manufacturers: Prysmian, Nexans, Southwire, United Wire of Canada or Approved Equivalent.

2.7.9 Acceptable manufacturer, multi-conductor, armoured control cables: Shawflex or Approved Equivalent.

2.8 Analog Control Wire

2.8.1 System description: 0-10 V and 4-20 mA signal wiring for control set-points and feedback. Does not apply to speciality signal conductors such as flow meters.

2.8.2 Allowable Construction:

.1 Cables in conduit: CIC

2.8.3 Conductor: #18 AWG, 7x26 stranded, copper or to match required cable impedance

2.8.4 Cable: individual wires formed into pairs or triads as required by the application. Provide multi-pair/multi-triad cables where indicated.

2.8.5 Insulation: PVC, 300 V, 90°C (dry and wet)

2.8.6 Shielding:

.1 Inner Shield: Aluminium/polyester tape shield over individual pairs or triads.

.2 Inner Drain Wire: 7-strand tinned copper drain wire.

.3 Outer Shield: Aluminium/polyester tape shield over cable.

.4 Outer Drain Wire: 7-strand tinned copper drain wire.

2.8.7 All cables to have a ripcord.

2.8.8 Jacket: 90°C (-40°C) PVC

2.8.9 cUL Flame test: FT4

2.8.10 Control cables shall meet CSA, C22.2 No. 239.

2.8.11 Acceptable manufacturers: Shawflex, Belden, or Approved Equivalent.

3 EXECUTION

3.1 Shipping and storage

3.1.1 Wire and cable shall be maintained in dry environment with ends sealed at all times.

3.1.2 Protect reels from damage.

3.1.3 Damaged reels shall be removed from site. Prior to removal from site reels shall be marked by the Contract Administrator to prevent reuse.

3.2 Power Wiring - General

3.2.1 Install wiring as follows:

.1 In cable trays in accordance with Section 16111 – Cable Tray

.2 In conduit systems in accordance with Section 16133 – Conduits, Conduit Fastenings and Fittings.

.3 In underground ducts in accordance with Section 16051– Installation of Cables in Ducts and Trenches.

3.2.2 All feeders shall run in continuous length between power supply point and the load. No splices will be allowed in feeder cable unless otherwise noted.

.1 Where conductors cannot be pulled in a single pull, consult the engineer who may redesign the run or permit splices.

3.2.3 Only circuits of the same voltage shall be installed in a common conduit or duct or share the same ground return line. Do not mix voltage in the same duct or conduit.

3.3 Armoured cables

3.3.1 Group cables wherever possible in channels.

3.3.2 Use sheaves/shoes or other guides to ensure smooth changes in direction and to minimize cable tension.

3.3.3 Install cable in trenches in accordance with Section 16051 – Installation of Cables in Ducts and Trenches.

3.3.4 Group cables wherever possible.

3.4 Control wiring

3.4.1 All cables and wires to be continuous runs unless otherwise noted.

3.4.2 Where control wiring terminates in or transitions through hazardous areas, the entire length shall be run as armoured cable.

3.4.3 Run all wiring in conduit or duct (underground wire) unless otherwise specified. Refer to this division and to the drawings for additional information, requirements and details.

3.4.4 Provide minimum 20% spare wiring or two (2) conductors (1 pair) whichever is greater for each run.

3.4.5 All wires must be tagged with pre-numbered slip-on markers. Allow for up to ten (10) characters per individual wire. No wrap around markers will be accepted.

3.4.6 Communication and Special Wire and Cable (Field)

.1 The Contractor shall provide all wiring and cable, including connectors, plugs and termination devices required for the wiring of the systems and equipment shown on the drawings, unless otherwise specified.

.2 Provide quantities and lengths of cable and wire type as recommended by the system equipment manufacturers. Do not de-rate any cabling and wire. No wire/cable to be sized less than 18 AWG unless approved by the Contract Administrator or unless a specific requirement of the equipment manufacturer.

.3 Provide, as part of shop drawing submittal, cable and wire specifications and data for each system. Include written proof that cable and wire meets requirements of equipment supplier.

.4 Coordinate with the manufacturer and other sections of these specifications to ensure proper conduit type (ie: metal) and sizes are provided.

.5 Any wire and cable installed that does not meet the wiring specifications of the equipment manufacturer shall be removed and replaced (including conduits, if necessary), at the Contractor's expense.

3.5 Communications Cables

3.5.1 Supply and install all communications cables to suit the communications system connection requirements.

3.5.2 All communications cables located outdoors or in classified areas are to be installed in dedicated rigid aluminum conduit unless otherwise indicated.

3.6 Testing

3.6.1 General

.1 Test all wire and cables prior to energization.

.2 Clean and dry ends of wire and cable prior to test.

.3 Provide a written (typed) report to suit the test results for each cable indicating:

.1 Equipment make/model and calibration data

.2 Operator name or employee number and initials

.3 Environmental conditions including temperature and approximate humidity (e.g. dry/damp/wet)

.4 Cable tag number, description (e.g #10 AWG, 3/C, TECK 90) and length under test

.5 Results in MΩ/unit length

.6 Reports may be handwritten in logbook or typed.

.4 Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.

.5 Disconnect sensing and protection equipment from the respective circuits to be megger tested including PT's and Surge Protectors.

.6 Do not perform megger tests on control circuits containing transistorized or solid-state components.

.7 Conduct tests in accordance with NETA (International Electrical Testing Association) standards.

.8 The Contractor shall repeat the test in the presence of the Contract Administrator for any cable listed in the test report, at the request of the Contract Administrator.

3.6.2 Power cables (types TECK, RW, RWU, STJ, AC90, etc)

.1 Perform 1000V DC insulation resistance test.

.2 Test each circuit with equipment disconnected.

.3 Test phase-to-phase and phase-to-ground.

.4 Take test results after one (1) minute at full voltage.

.5 Cables with an insulation resistance > 50 MΩ shall be considered acceptable.

.6 Cables with an insulation resistance of less than 50 MΩ shall be reported to the Contract Administrator for investigation and remedial action shall be taken by the Contractor after discussion with the Contract Administrator.

.7 Cables with an insulation resistance <2 MΩ shall be removed and replaced.

3.6.3 Control cables

.1 Perform 500V DC insulation resistance test.

.2 Test each control circuit to ground only.

.3 Take test results after one (1) minute at full voltage

.4 Cables with an insulation resistance > 50 MΩ shall be considered acceptable.

.5 Cables with an insulation resistance of less than 50 MΩ shall be reported to the Contract Administrator for investigation and remedial action shall be taken by the Contractor after discussion with the Contract Administrator.

.6 Cables with an insulation resistance <2 MΩ shall be removed and replaced.

.7 Summit the testing results as a formal shop drawing submission

3.6.4 Instrumentation and Thermocouple Wiring

.1 Check continuity of each wire using ohm meter or DC buzzer. Megger or 120V filament lamp testing is not acceptable.

.2 Test thermocouple wiring for continuity and polarity in accordance with manufacturer's recommendations.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 Provide splitters, junction boxes, pull boxes and wiring cabinets for the power, control and communications wiring systems as shown on the drawing and as required to complete the wiring systems described in the drawings.

1.2 Related Sections

1.2.1 Section 01330 – Submittals

1.2.2 Section 16090 – Equipment Identification

1.3 Shop Drawings and Product Data

1.3.1 Submit shop drawings and product data for junction and pull boxes in accordance with Section 01330 – Submittal Procedures.

1.4 General Requirements

1.4.1 All mounting hardware shall be of non-corrosive type material including:

.1 Stainless steel

.2 Aluminium

.3 PVC encapsulated metal

1.4.2 Splitter, Junction Boxes, Pull Boxes and Cabinets installed indoors or outdoors shall be ULC or cUL listed.

1.5 Enclosure Ratings

1.5.1 Dry, non-corrosive areas: NEMA 12, sprinklerproof

1.5.2 Wet, damp and/or corrosive areas: NEMA 4X.

2 PRODUCTS

2.1 PVC Pull and Junction Boxes

2.1.1 Provide cast PVC boxes with external mounting lugs.

2.1.2 Provide PVC Cover with retaining screws and seamless gasket all around.

2.1.3 Acceptable manufacturer: same as conduit system or approved equivalent.

2.2 Aluminium Pull and Junction Boxes, Non-Classified

2.2.1 Provide welded or die-cast aluminium boxes with

2.2.2 Covers shall be hinged covers with minimum two (2) retained screw fasteners and a seamless gasket all around.

2.2.3 Acceptable manufacturer: same as conduit system.

2.3 Cabinets

2.3.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

2.3.2 Type T: sheet steel cabinet, with hinged door, latch, lock, two (2) keys, containing Unistrut backing flush mounted.

2.3.3 Cabinets to be rated NEMA 4X unless indicated otherwise on the drawings.

3 EXECUTION

3.1 Junction, Pull Boxes and Cabinets Installation

3.1.1 Boxes shall be surface mounted in unfinished areas and flush mounted in finished (e.g. office) areas.

3.1.2 Install pull boxes in inconspicuous but accessible locations.

3.1.3 Mount cabinets with top not higher than 2m above finished floor.

3.1.4 Install terminal block as indicated in Type T cabinets.

3.2 Identification

3.2.1 Provide equipment identification in accordance with Section 16090 – Equipment Identification.

END OF SECTION

1 GENERAL

1.1 References

1.1.1 Ontario Electrical Safety Code – 2024 and ESA latest bulletins.

1.2 General Requirements

1.2.1 All mounting hardware shall be of non-corrosive type material including:

.1 Stainless steel

.2 Aluminium

.3 PVC encapsulated rigid steel

1.2.2 Outlet and Conduit Boxes must be of the same material as the conduit application.

1.2.3 Outlet boxes, conduit boxes and fittings installed indoors in classified areas shall be rated NEMA 7 to suit hazardous environments.

1.2.4 All outlet boxes, conduit boxes and fittings installed indoors or outdoors shall PVC encapsulated rigid metal type to match PVC encapsulated rigid steel conduit applications.

1.2.5 All Junction Boxes, Pull Boxes and Cabinets installed outdoors shall be of the same manufacturers as the conduit application and rated NEMA 4X.

2 PRODUCTS

2.1 Outlet and Conduit Boxes General

2.1.1 Size boxes in accordance with code requirements.

2.1.2 102mm square or larger outlet boxes as required for special devices.

2.1.3 Gang boxes where wiring devices are grouped.

2.1.4 Blank cover plates for boxes without wiring devices.

2.1.5 347 V outlet boxes for 347 V switching devices.

2.1.6 Combination boxes with barriers where outlets for more than one (1) system are grouped.

2.1.7 All boxes used with exposed conduits to be galvanized rigid metal. Boxes to be as manufactured by Appleton or equal.

2.1.8 Each light, switch, receptacle and/or outlet shall be provided with suitable outlet box, each approved for the particular area which it is to be installed.

2.1.9 One outlet box shall be installed per switch, receptacle, light, etc.

2.1.10 Provide PVC encapsulated outlet and conduit boxes to suit all PVC encapsulated conduit applications (for ex. in classified areas). Acceptable product: Plasti-Bond.

2.2 Sheet Steel Outlet Boxes

2.2.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38mm or as indicated. 102mm square outlet boxes when more than one (1) conduit enters one (1) side with extension and plaster rings as required.

2.2.2 Electro-galvanized steel utility boxes for outlets connected to surface mounted EMT conduit, minimum size 102 x 54 x 48mm.

2.2.3 102mm square or octagonal outlet boxes for lighting fixture outlets.

2.2.4 102mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

2.3 Masonry Boxes

2.3.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 Concrete Boxes

2.4.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 Conduit Boxes

2.5.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.6 Outlet Boxes for Non-metallic Sheathed Cable

2.6.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63mm with two (2) double clamps to take non-metallic sheathed cables.

2.7 Fittings - General

2.7.1 Bushing and connectors with nylon insulated throats.

2.7.2 Knock-out fillers to prevent entry of debris.

2.7.3 Conduit outlet bodies for conduit up to 32m and pull boxes for larger conduits.

2.7.4 Double locknuts and insulated bushings on sheet metal boxes.

2.8 Service Fittings

2.8.1 ‘High tension’ receptacle fitting made of two (2) piece stainless steel housing finish for one (1) single receptacle(s). Bottom plate with two (2) knockouts for centred or offset installation. 12 x 102mm extension piece as indicated.

2.8.2 Pedestal type 'low tension' fitting made of two (2) piece stainless steel housing finish to accommodate two (2) Amphenol jack connectors.

3 EXECUTION

3.1 Installation

3.1.1 Support boxes independently of connecting conduits.

3.1.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

3.1.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.

3.1.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section describes the requirements for conduits and associated fittings.

1.2 Related Sections

1.2.1 Section 07900 – Joint Sealants

1.3 Scope

1.3.1 Provide a complete conduit system in accordance with the drawings and specifications.

1.3.2 Seal conduits against propagation of water, corrosive gases, fire and/or smoke.

1.4 General Requirements

1.4.1 The requirements of this section are generic and details and/or requirements shown on the drawings shall take precedence.

1.4.2 Provide conduits per the following:

Location	Area Classification	Application	Conduit Material
Indoors: Offices, Meeting Rooms, Washrooms, Laundry Rooms, Kitchens, Control Rooms, Office Hallways, Laboratories Surface mount and embedded	Unclassified Ordinary non-corrosive and dry locations	Power, control, and communication wiring, fibre optic cables.	EMT
Indoors: Process Areas Electrical Rooms	Unclassified	Power & control wiring, fibre optic cables.	PVC
Indoors: Process Areas	Unclassified	Copper communications cables, VFD cables to motors, Ultrasonic Level	Aluminium

Electrical Rooms		Transmitter, Level Element wiring.	
All except underground	All	Life safety	Aluminium, colour: red.
All except buried	Class I, Div 1 or 2	All	Aluminium
Outdoors, Above Grade, building roof	Unclassified	All	Aluminium
Underground	Unclassified	All	PVC
Concrete Encased	Unclassified	All	PVC
Concrete Encased	Class I, Div 1 or 2	All	Aluminium (protected)

1.4.3 The conduit sizes shown on the drawing are a minimum and are for a single feed. Size all conduits for multiple feeders in accordance with the Electrical Code and the spare space requirements of 16010.

1.4.4 Minimum conduit size for lighting and power circuits: 19mm.

1.5 References

1.5.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.2 No. 18-92, Outlet Boxes, Conduits Boxes, and Fittings.

.2 CSA C22.2 No. 45-M1981 (R1992), Rigid Metal Conduit.

.3 CSA C22.2 No. 56-1977(R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.4 CSA C22.2 No. 83-M1985 (R1992), Electrical Metallic Tubing.

.5 CSA C22.2 No. 211.2-M1984 (R1992), Rigid PVC (Un-plasticized) Conduit.

.6 CAN/CSA C22.2 No. 227.3-[M91], Flexible Non-metallic Tubing.

2 PRODUCTS

2.1 General

2.1.1 Fittings: manufactured for use with conduit specified. The fitting material and coating shall be the same as conduit used in the application.

2.2 Expansion/Deflection Fittings

2.2.1 Provide at all structural expansion joints.

2.2.2 Provide on all interior conduits where required to suit a 14°C maximum temperature variation.

2.2.3 Provide on all exterior, above-grade conduits. Design for temperature range of 75°C. Each straight run shall have a minimum of one (1) fitting.

2.2.4 Install in accordance with manufacturer's instructions.

2.3 Rigid Aluminium Conduit

2.3.1 Meet requirements of CSA C22.2 No. 45.2

2.3.2 Provide tracer wires for all buried conduits, including spares, and label accordingly for their dedicated respective use.

2.3.3 Rigid Aluminium Conduit to be manufactured of 6063 alloy in temper designation T-1 listed by U.L.6 "Standard for Rigid Metal Conduit" and manufactured to ANSI C80.5

2.3.4 Fittings:

.1 Type: Threaded, copper free - Set screw and fittings not permitted.

.2 Insulated Bushing

.1 Material: Cast aluminium with integral insulated throat, rated for 150°C.

.2 Manufacturers and Products: O-Z/Bedney: Type AB

.3 Grounding Bushing

.1 Material: Cast aluminium with integral insulated throat rated for 150°C, with solder-less lugs.

.2 Manufacturers and Products: O-Z/Bedney: Type ABLG or approved equivalent.

.4 Conduit Hub

.1 Material: Cast aluminum with integral insulated throat.

.2 UL listed for use in wet locations.

.3 Manufacturers and Products:

.1 O-Z/Gedney: Type CHA

.2 Thomas & Betts: Series 370AL

.3 Meyers: Series SA

.5 Conduit Bodies

.1 Manufacturers and Products (For normal Conditions)

.1 Appleton: Form 85 threaded unilets

.2 Crouse-Hinds; Mark 9 or Form 7-SA threaded condulets

.3 Killark: Series O electrolets

.4 Or, Approved Equivalent

.6 Couplings: As supplied by conduit manufacturer

.7 Conduit Sealing Fitting Manufacturers and Products:

.1 Appleton: Type EYF-AL or EYM-AL

.2 Crouse-Hinds; Type EYS-SA or EZS-SA

.3 Killark: Type EY or EYS

.4 Or, Approved Equivalent

.8 Drain Seal Manufacturers and Products

.1 Appleton: Type EYDM-A

.2 Crouse-Hinds; Type EYD-SA or EZD-SA

.3 Or, Approved Equivalent

.9 Drain/Breather Fittings Manufacturers and Products

.1 Appleton: Type ECDB

.2 Crouse-Hinds; ECD

.3 Or, Approved Equivalent

.10 Expansion Fittings Manufacturers and Products

.1 Deflection/Expansion Movement: Steel City: Type DF-A

.2 Expansion Movement Only: Steel City: Type AF-A

.3 Or, Approved Equivalent

.11 Cable Sealing Fittings: To form watertight nonslip cord or cable connection to conduit.

.1 Bushing: Neoprene at connector entry

.2 Manufacturer: Appleton: CG-S or Approved Equivalent

2.4 PVC Conduit

2.4.1 Meet requirements of CSA C22.2 No. 211.2 and NRMA TC 2.

2.4.2 Suitable for areas NOT exposed to physical damage, underground direct burial, concealed or direct sunlight exposure and 90°C insulated conductors.

2.4.3 Unless shown otherwise on drawings or required by code, provide schedule 80 PVC conduit under equipment pads and schedule 40 PVC conduit elsewhere.

2.4.4 PVC Conduit and Tubing

.1 Meet requirements of NEMA TC-3.

.2 Type: PVC, slip-on

2.5 Conduit Fastenings

2.5.1 One (1) hole steel straps to secure surface conduits NPS 2 50mm and smaller. Two (2) hole steel straps for conduits larger than NPS 2 50mm.

2.5.2 Beam clamps to secure conduits to exposed steel work.

2.5.3 Channel type supports for two (2) or more conduits at 15m oc.

2.5.4 Threaded rods, 6mm dia., to support suspended channels.

2.5.5 All mounting hardware used outdoors and in corrosive and/or classified areas shall be of non-corrosive type material compatible with the conduit material including:

.1 Stainless steel

.2 Aluminium

.3 PVC encapsulated steel

2.6 Flexible, Nonmetallic, Liquid-Tight Conduit

2.6.1 Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.

2.6.2 Body/compression nut (gland) design to assure high mechanical pull-out strength and watertight seal.

2.6.3 Manufacturers and Products

.1 Carlon: Type LT

.2 O-Z/Gedney: Type 4Q-P

.3 Thomas & Betts: Series 6300

.4 Or, Approved Equivalent

2.7 Flexible Metallic Conduit

2.7.1 Meet requirements of CSA C22.2 No. 56, liquid-tight flexible metal.

2.8 Expansion Fittings for Rigid Conduits

2.8.1 Weatherproof expansion fittings with internal bonding assembly suitable for 200mm linear expansion.

2.8.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19mm deflection in all directions.

2.8.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.9 Fish Cord

2.9.1 6mm polypropylene in all empty conduits.

3 EXECUTION

3.1 Installation, General

3.1.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

3.1.2 Conceal all conduits in finished rooms that are equipped with suspended ceilings.

3.1.3 Install sleeves where conduits pass through slab or wall.

3.1.4 Do not pass conduits through structural members except as indicated.

3.1.5 Install fish cord in empty conduits.

3.1.6 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

3.1.7 Dry conduits out before installing wire.

3.1.8 Install conduits with minimum clearances as follows:

.1 To parallel steam or hot water line: 75mm

.2 To steam or hot water line crossover: 25mm

.3 To infrared or gas fired heaters: 1.5m

.4 To any building surface in Damp/Wet and/or Corrosive areas: 12 mm

.5 Between conduits containing copper communication lines and any power circuit rated at more than 600 V or 1000 A: 600 mm

3.2 Concealed Conduits

3.2.1 Run 2-25mm spare conduits up to ceiling space and 2-25mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.

3.3 Surface Conduits

3.3.1 Run parallel or perpendicular to building lines.

3.3.2 Run conduits in flanged portion of structural steel.

3.3.3 Group conduits in parallel runs.

3.4 Bends, General

3.4.1 Install concealed raceways with a minimum of bends in the shortest practical distance.

3.4.2 Make bends and offsets of longest practical radius.

3.4.3 Bends in conduits and ducts for fiber optic cables shall be not less than 20 times cable diameter, 375mm minimum.

3.4.4 Make bends and kicks in parallel or banked runs from same center or centerline with same radius so that bends and kicks are parallel.

3.5 Support

3.5.1 Support from structural members only, at intervals not exceeding Canadian Electrical Code requirements and, in any case, not exceeding 2.5 metres. Do not support from piping, pipe supports or other raceways.

3.5.2 Provide supports that are impervious to galvanic reaction between dissimilar metals.

3.5.3 Support aluminum conduit on concrete surfaces with spacers or framing channel constructed of stainless steel, aluminum or non-metallic material.

3.5.4 Do not overtighten supports against conduit. Allow for conduit expansion and contraction.

3.5.5 Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit allow 25 percent extra spaces for future conduit.

3.5.6 Application/Type of Conduit Strap

.1 Rigid Steel or EMT (Electrical Metallic Tubing) Conduit: Zinc coated steel, pre-galvanized steel or malleable iron.

.2 PVC Coated Rigid Steel Conduit: PVC coated metal.

.3 Non-metallic Conduit: Non-metallic or PVC coated metal.

3.5.7 Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

.1 Wood: wood screws

.2 Hollow Masonry Units: toggle bolts

.3 Concrete or Brick: expansion shields or threaded studs driven in by powder charge with lock washers and nuts

.4 Steelwork: machine screws

.5 Location/Type of Hardware

.1 Dry, noncorrosive areas: galvanized

.2 Wet, noncorrosive areas: stainless steel

.3 Corrosive areas: stainless steel

3.5.8 Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers

3.6 Penetrations

3.6.1 Make penetrations at right angles, unless otherwise shown.

3.6.2 Notching or penetration of structural members, including footings and beams, is not permitted.

3.6.3 Fire-Rated walls, floors, or ceilings: fire stop openings around penetrations to maintain existing fire-resistance rating.

3.6.4 Apply single layer of wraparound duct band to all metallic conduit protruding through concrete floor slabs to a point 50mm above and 50mm below concrete surface.

3.6.5 Where conduits protrude through floor slabs in areas subject to mechanical damage, provide heavy steel guards around conduits from grade to a height of 1200 mm above grade.

.1 Leave drainage holes at base of guards.

3.6.6 Concrete walls, floors, or ceilings (aboveground): provide non-shrink grout dry-pack or use watertight seal device.

3.6.7 Entering Structures

.1 General: Seal raceway at the first box or outlet with listed water-stopping sealant to prevent the entrance of gases or liquids from one area to another.

.2 Arrange conduits to allow water to drain away from seals.

.3 Concrete roof or Membrane Waterproofed Wall or Floor:

.1 Provide a watertight seal.

.2 Without concrete encasement: Install watertight entrance seal device on each side.

.3 With concrete encasement: Install watertight entrance seal device on the accessible side.

.4 Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.

.5 Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

.4 Heating, Ventilating, and Air Conditioning Equipment

.1 Penetrate equipment in area established by manufacturer.

.2 Terminate conduit with flexible PVC (Polyvinyl chloride) encapsulated metallic conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.

.3 Seal penetration with Type 5 sealant, as specified in Section 07900 – Joint Sealants.

.5 Corrosive-Sensitive Areas

.1 Seal all conduits passing through chlorine/chemical room walls.

.2 Seal conduit entering equipment panel boards and field panels containing electronic equipment.

.3 Seal penetration with Type 5 sealant, as specified in Section 07900 – Joint Sealants.

.6 Existing or Precast Wall (Underground): Core drill wall and install a watertight entrance seal device.

.7 Non waterproofed Wall or Floor (Underground without Concrete Encasement)

.1 Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.

.2 Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint on each side.

.8 Maintenance holes and Hand holes

.1 Metallic Raceways: Provide insulated grounding bushings.

.2 Non-metallic Raceway: Provide bell ends flush with wall.

.3 Install such that raceways enter as near as possible to one end of wall unless otherwise shown.

3.7 Conduits In Cast-In-Place Concrete

3.7.1 All cast in place conduit installations not specified on the drawings must be approved by the Contract Administrator.

3.7.2 Locate to suit reinforcing steel. Install in centre third of slab.

3.7.3 Protect conduits from damage where they stub out of concrete.

3.7.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

3.7.5 Do not place conduits in slabs in which slab thickness is less than four (4) times conduit diameter.

3.7.6 Encase conduits completely in concrete with minimum 25mm concrete cover.

3.7.7 Organize conduits in slab to minimize crossovers.

3.8 Conduits In Cast-In-Place Slabs On Grade

3.8.1 All cast in place conduit installations not specified on the drawings must be approved by the Contract Administrator.

3.8.2 Run conduits 25mm and larger below slab and encased in 75mm concrete envelope. Provide 50mm of sand over concrete envelope below floor slab.

3.9 Conduits Underground

3.9.1 Slope conduits to provide drainage.

3.9.2 Waterproof joints (except PVC) with heavy coat of bituminous paint.

3.9.3 Provide horizontal expansion joints at building foundations and vertical expansion joints where conduits rise out of ground.

3.10 Connections to Equipment, Unclassified areas

3.10.1 Make rigid connection to equipment

3.10.2 In unclassified areas and where the conduit size is 103mm or less use flexible, liquid-tight conduit.

3.10.3 Conduit size over 103 mm: nonflexible.

3.10.4 Wet or Corrosive areas: flexible, non-metallic, liquid-tight.

3.10.5 Dry Areas: flexible, metallic liquid-tight.

3.11 PVC Conduit

3.11.1 Debur all ends prior to making joints.

3.11.2 Solvent Weld all joints using manufacturer's recommended solvent.

3.11.3 Install such that joint is watertight.

3.11.4 Adapters:

.1 PVC to metallic fittings: PVC terminal type

.2 PVC to rigid metal conduit: PVC female adapter

3.11.5 Belled End Conduit: Bevel the unbelled end of the joint prior to joining.

3.11.6 PVC Conduit:

.1 Bends 30° and larger: provide factory-made elbows.

.2 Use manufacturer's recommended method for forming smaller bends and kicks.

3.11.7 Do not install conduit with scorch marks.

3.12 Aluminum Conduit

3.12.1 Bend conduit cold.

3.12.2 Do not install kinked or flattened conduit.

3.12.3 Protect aluminum conduits in contact with concrete with:

.1 Apply bituminous Paint, shrink wrap or other protective coating acceptable to the Engineer and AHJ (Authority Having Jurisdiction).

.2 Apply protective coatings in accordance with the manufacturer's recommendations

.3 Extend protection to 100 mm minimum from concrete.

3.12.4 Field threads must be of sufficient length to draw conduits up tight.

3.13 Liquid-Tight Flex

3.13.1 Control wiring terminations to be in Liquid tight, PVC encapsulated steel armoured flex to suit the transition from conduit or junction box to the respective equipment and instrumentation.

3.13.2 Liquid tight flex shall not exceed 2m in length.

3.13.3 Bends shall exceed the minimum allowable conductor bending radius and shall allow conduit flexibility.

3.13.4 Length: 450mm minimum, 1500mm maximum.

END OF SECTION

1 GENERAL

1.1 Shop Drawings and Product Data

1.1.1 Submit shop drawings and product data in accordance with Section 01330 - Submittal Procedures.

2 PRODUCTS

2.1 Colours

2.1.1 Provide wiring device bodies and faceplates in the following colours unless otherwise noted on the drawings:

.1 Switches & receptacles in process areas: Brown

.2 Switches & receptacles in office areas: White

.3 Isolated-ground receptacles: Orange

2.2 Switches

2.2.1 15A and 20A, 120V, single pole, double pole, three-way, and four-way switches.

2.2.2 Switches to be suitable for connected loads i.e.: 15A or 20A as required and/or shown on the drawings.

2.2.3 Outdoor and weatherproof switches shall have plunger-type operators.

2.2.4 Manually operated general purpose AC switches with the following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver alloy contacts.

.3 Urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

2.2.5 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

2.2.6 Switches of one (1) manufacturer throughout project.

2.2.7 Acceptable Suppliers:

.1 Hubbell

.2 Pass and Seymor

.3 Smith and Stone

.4 Or, Approved Equivalent

2.3 Receptacles

2.3.1 Provide extra-heavy duty duplex receptacles, CSA type 5-15 R, 125 V, 15A, U ground with the following features where shown on drawings:

.1 Suitable for 10 AWG for back and side wiring.

.2 Break off links for use as split receptacles.

.3 One-piece plated brass strap.

.4 Eight (8) back wired entrances, four (4) side wiring screws.

.5 Nickel-plated contacts

.6 Triple wipe contacts and riveted grounding contacts.

2.3.2 Single receptacles CSA type 5-15R, 125V, 15A, U ground with the following features:

.1 Ivory, brown urea moulded housing.

.2 Suitable for 10 AWG for back and side wiring.

.3 Four (4) back wired entrances, two (2) side wiring screws.

2.3.3 Other receptacles with ampacity and voltage as indicated.

2.3.4 Receptacles of one (1) manufacturer throughout project.

2.3.5 Provide while-in-use covers for weatherproof receptacles.

2.3.6 Receptacles to be sized according to related lighting panel branch circuit breaker.

2.3.7 Non-Hazardous Products - Acceptable Suppliers:

.1 Hubbell

.2 Leviton

.3 Cooper

.4 Or, Approved Equivalent

2.4 Ground Fault Circuit Interrupter Receptacles

2.4.1 Provide ground fault receptacles to meet NEMA 5-15 or 5-20 as shown on drawings and with the following features:

.1 Red or yellow trip indication light

.2 Terminals suitable for #10 to #14 AWG stranded conductors

.3 Weather resistant

.4 Suitable for back and side wiring

.5 Body Material: Nylon

.6 Strap material: Nickel-plated steel

.7 Contacts material: Brass

.8 Terminal clamp & screw material: Nickel-plated, brass

2.4.2 GFCI (Ground-Fault Circuit Interrupter) Receptacles - Acceptable Suppliers:

.1 Cooper

.2 Hubbell

.3 Approved Equivalent

2.5 Receptacles, 600V

2.5.1 Provide 600V pin and sleeve receptacles where shown on the drawings.

2.5.2 Current rating: to match feeder breaker

2.5.3 Contact material: brass

2.5.4 Provide with:

.1 Mechanically-interlocked, non-fused switch

.2 NEMA 4X, non-metallic enclosure

.3 Provision for lock-off

.4 Nameplate to show source of power

2.5.5 Acceptable suppliers:

.1 Hubbell

.2 Cooper

.3 Or, Approved Equivalent

2.6 Receptacles, Other

2.6.1 Supply and install 240/208V receptacles where shown on drawings.

2.7 Cover Plates

2.7.1 Provide cover plates for wiring devices.

2.7.2 Cover plates from one (1) manufacturer throughout project.

2.7.3 Sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.

2.7.4 Stainless steel, 1mm thick cover plates, thickness 2.5mm for wiring devices mounted in flush mounted outlet box.

2.7.5 PVC cover plates for wiring devices mounted in surface mounted FS or FD type conduit boxes.

2.7.6 Receptacles and switches in unfinished areas shall be complete with cover plates to match related boxes.

2.7.7 Cover plates shall be provided for all blanked off outlets.

2.7.8 One (1) piece gang plates shall be used at locations where more than one (1) device is to be mounted adjacent to each other.

.1 Weatherproof double lift spring loaded cast aluminium cover plates, complete with gaskets for duplex receptacles as indicated.

.2 Weatherproof cover plates complete with gaskets for single receptacles or switches. Cover plates to be Scepter type VSC 15/10 or WDR 15/10.

3 EXECUTION

3.1 Installation

3.1.1 Switches:

.1 Install single throw switches with handle in “UP” position when switch closed.

.2 Install switches in gang type outlet box when more than one (1) switch is required in one (1) location.

.3 Mount toggle switches at height specified in Section 16010 – Electrical General Requirements or as indicated.

3.1.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one (1) receptacle is required in one (1) location.

.2 Mount receptacles at height specified in Section 16010 – Electrical General Requirements or as indicated.

.3 Provide label to show feeder breaker and panel.

.4 Where split receptacle has one (1) portion switched, mount vertically and switch upper portion.

3.1.3 Cover Plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface mounted boxes.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 The specification includes general requirements for AC Induction motors.

1.1.2 Refer to driven equipment specifications for specific application requirements.

1.1.3 Provide power factor correction capacitors where indicated.

1.2 General

1.2.1 Requirements in the equipment sections in other divisions (e.g., div 11, 13 or 15) shall take precedence over contradictory requirements in this section.

1.2.2 The Contractor shall supply and install the equipment specified herein and in the driven-equipment sections and as shown on the contract drawings.

1.3 References

1.3.1 NEMA Standard MG1, Motors and Generators

1.3.2 NEMA Standard MG2, Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

1.3.3 CSA C22.2 No. 100, Motors and Generators

1.3.4 CSA C390, Test methods, marking requirements, and energy efficiency levels for three-phase induction motors

1.3.5 C22.2 NO. 145-11, Electric motors and generators for use in hazardous (classified) locations

1.3.6 IEEE 114, Test Procedure for Single Phase Motors

1.3.7 IEEE 841 Petroleum and Chemical Industry—Premium- Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 370 kW (500 hp)

1.4 Definitions

1.4.1 TEFC: Totally-enclosed, fan-cooled

1.4.2 TEEP: Totally-enclosed, explosion proof

1.4.3 ODP: Open, drip-proof

1.5 Quality Assurance

1.5.1 IEEE 117 classification tests.

1.5.2 All motors shall be constructed in accordance with latest, CEMA, NEMA, ANSI standards.

1.5.3 Verify motor performance in accordance with CSA C390.

1.5.4 Unless noted otherwise, prior to shipment from motor manufacturer's factory, subject motors to routine tests as defined by NEMA MG1.

1.5.5 Perform tests at motor full speed and at each intermediate speed for multi-speed motors.

1.5.6 Statically and dynamically balance motors over 0-125% speed range.

1.6 Submittals

1.6.1 Submit the following as shop drawings:

.1 Efficiency and power factor at 1/2, 3/4 and full load.

.2 Outline dimensions of each motor, showing sizes and location of terminal boxes and horizontal and vertical clearances necessary for maintenance purposes

.3 Mechanical mounting information

.4 Total weight and heaviest shipping weight of motor

.5 Design information regarding shaft and sheave sizes for coordination with driven equipment.

.6 Outline dimensions and technical data for auxiliary equipment, such as power-factor correction capacitors, surge capacitors and arresters

.7 Permissible number of fully loaded and unloaded starts over a defined time period (e.g. starts per hour)

.8 Electrical schematic of windings and terminations

.9 Electrical schematic and wiring diagrams of auxiliary systems, such as resistance temperature detectors (RTDs), thermistors, temperature indicators, vibration detectors, temperature selector switches, temperature relays, leak detectors (for submersible motors) and anti-condensation heaters.

.10 Nameplate drawings

1.6.2 Submit shop drawing information with driven equipment submittal.

1.7 Delivery, Storage, and Handling

1.7.1 Inspect the motor thoroughly for damage upon delivery to the job site.

1.7.2 Handle in accordance with the manufacturer’s instruction. Under no circumstances shall the motor be lifted by using the shaft, as an attachment point.

1.7.3 Store motors under cover in a clean, dry location and protect from rapid temperature changes.

1.7.4 If storage is anticipated to be longer than two (2) months, take the following additional steps:

.1 Motors with sleeve bearings shall have the oil reservoirs filled to the proper level with the specified oil.

.2 Motors with anti-friction bearings shall receive an initial change of grease and then be re-greased every six months until fully commissioned and operational.

.3 The motor shaft braces shall be removed, and the motor shaft rotated every two weeks. The shaft braces shall be replaced prior to relocation to the installation site. Under no circumstances shall the motor be lifted without the braces in place.

1.8 Operation and Maintenance Manuals

1.8.1 Ship two (2) copies of the motor operation and maintenance manual with each motor. Include instruction leaflets and instruction bulletins for the complete storage, handling and installation of the motor.

1.8.2 Submit bound and indexed copies of operating and maintenance manuals including, but not limited to, the following:

.1 Storage instructions

.2 Complete parts list

.3 Installation instructions

.4 Operating instructions

.5 Maintenance instructions

.6 Factory or Field test results

1.9 Site Conditions

1.9.1 Site operating conditions are as follows:

.1 Indoor locations: 40°C maximum/-18°C minimum, air ambient temperature.

.2 Outdoor locations: 40°C maximum/-40°C minimum, air ambient temperature.

.3 < 1000 m above sea level

.4 Indoor locations: 95% maximum relative humidity (non-condensing).

2 PRODUCTS

2.1 General Requirements

2.1.1 Unless noted otherwise, design for the following voltages and characteristics:

.1 115 V, single phase, 60 Hz - for motors 0.37 kW and below

.2 575 V, three phase, 60 Hz - for motors 0.55 kW and up

.3 75 kW and larger to be suitable for solid state reduced voltage starting.

2.1.2 Motors and individual components thereof to perform at full nameplate rating in ambient conditions specified.

2.1.3 Unless otherwise noted, motor power rating indicated represents a nominal rating. Consult related driven equipment manufacturer for exact requirements and supply a higher base rating (without service factor multiplier) if necessary to meet equipment operational requirements.

2.1.4 Provide design B squirrel cage induction motor where this design meets starting and operating requirements of the driven equipment. Minimum starting and breakdown torque as indicated in EEMAC MG1. If larger load torque or WK^2 requirements are encountered, other motor design type selection is acceptable subject to prior acceptance by Engineer.

2.1.5 All motors shall be suitable for across-the-line starting.

.1 Motors shall also be suitable for specified starting methods shown on the drawings or described in the specifications.

2.1.6 Design motors to operate continuously at rated load without exceeding maximum temperature rise above ambient temperature as indicated.

2.1.7 Design motors to operate continuously at rated load under a combination of ±10% voltage variation, 2% phase voltage imbalance without the winding hot-spot temperature exceeding the insulation class rating.

2.1.8 Do not exceed the maximum locked rotor current values as listed in EEMAC Standard MG1 for the specified EEMAC design and rating.

2.1.9 Pulsating motor currents: Full load and peak current variations to comply with EEMAC MGI-20.82.

2.1.10 Provide class F Insulation except as noted.

2.1.11 Provide motors suitable for operation with emergency generating set which has a 25% drop in rated voltage during starting of large motors.

2.1.12 Non-compliance: Special motors forming part of an integral, standard manufactured equipment assembly, such as valve operators, damper motors, submersible pumps, metering pumps and hoists, which require non-standard (non-EEMAC) design, mounting or housing, to be accepted in writing by the Engineer and of the type recommended by manufacturer for application indicated. Comply with functional and performance requirements stated herein and in driven equipment specification section.

2.2 Sound

2.2.1 Maximum overall sound pressure level: For motor rated 22 kW and larger, unless otherwise indicated: 65 dBA at 1 m. Measure at 4 points evenly spaced around the motor. Refer to driven equipment specification for additional noise level restrictions.

2.2.2 The noise level at base speed of each motor shall comply with NEMA MG1.

2.3 Constant Speed Motors

2.3.1 Minimum service factor of 1.25

2.3.2 Motors greater than 50 hp shall be suitable for reduced-voltage, soft starting.

2.3.3 Unless otherwise indicated, design motor for a minimum number of hot starts per hour as determined by driven equipment manufacturer, but not less than two.

2.4 Two-Speed Motors

2.4.1 Same minimum NEMA (National Electrical Manufacturers Association) torques for a given NEMA design, power rating and speed as for single-speed motors.

2.5 Inverter Duty Motors

2.5.1 All motors driven by variable speed drives shall meet NEMA MG-1 part 31

2.5.2 Motor shall normally be operated from an IGBT (insulated-gate bipolar transistor) based PWM type variable frequency drive (VFD).

2.5.3 Provide motors suitable for operation on variable frequency drives without restrictions or limitations for the length of feeder cable between motor and drive or for the switching frequency. If filters are required to suit the supplied motors, the contractor shall supply without additional costs to the Owner.

2.6 Service Factors

2.6.1 Constant speed & two-speed applications <100 hp: 1.25

2.6.2 Constant speed & two-speed applications <100 hp: 1.15

2.6.3 Motors on variable speed drives: 1

2.6.4 Size motors for duty point conditions without including service factor.

2.7 Efficiency and Power Factor

2.7.1 Measure motor efficiency in accordance with CSA C390.

2.7.2 Motors shall be NEMA premium efficiency per NEMA MG-1, where the NEMA premium efficiency tables apply except that:

.1 NEMA Premium Efficiency ratings are not required for multispeed, short-time rated, submersible motors, or for motors driving gates, valves, elevators, cranes, trolleys, and hoists.

2.7.3 The minimum guaranteed full-load efficiency for motors larger than 375 kW not covered by the NEMA premium efficiency tables shall be 95.0%.

2.7.4 The minimum guaranteed full-load efficiency for submersible motors rated greater than 50 kW and for all submersible motors designed for non-intermittent duty shall be 90%.

2.7.5 The minimum guaranteed full load power factor shall be 88.3.

2.8 Terminal Boxes

2.8.1 Provide waterproof, oversized terminal boxes.

2.8.2 NEMA position F1 (left hand side when facing the shaft), convertible to F2.

2.8.3 Provide solderless type motor lead terminations for incoming cable connections and clamp terminal for ground connections.

2.8.4 A frame grounding lug shall be provided in each conduit box.

2.8.5 Seal frame to terminal box cable passage to prevent the entrance of moisture or foreign matter.

2.8.6 Provide gaskets between all mating surfaces.

2.8.7 Provide separate termination box for ancillary devices.

2.9 Mechanical Construction

2.9.1 The motors shall be capable of being floor, ceiling or wall mounted. The shaft location in all cases shall be parallel to the horizontal plane.

2.9.2 All windings shall be copper with end turn lacing every two (2) slots. A varnish treatment shall be applied to all motors designed for mill and chemical duty. This treatment shall allow installation in environments where relative humidity can reach 100%.

2.9.3 All dimensions including that of the motor shaft shall be in accordance with NEMA MG-1. Where shaft modifications are required, they will be noted in the motor schedule.

2.9.4 Motor leads shall have an insulation class equal to or better than the insulation class of the motor windings.

2.10 Construction, General

2.10.1 Refer to the driven-equipment specification for additional details.

2.10.2 Motor enclosures shall meet or exceed the requirements of the OESC for the specific application and location.

2.10.3 Where the location meets more than one description, e.g. wet & corrosive, products shall be more stringent requirements for both locations.

2.11 Construction, Ordinary Locations

2.11.1 Enclosure type: ODP.

2.11.2 Guard bottom ventilation openings with baffles to prevent direct entrance of liquids that might be released by pump seal failure. Provide drip covers for the top side openings.

2.11.3 Vertical motors: Guard bottom ventilation openings with baffles to prevent direct entrance of liquids that might be released by pump seal failure. Provide drip covers for the top side openings.

2.11.4 Provide space heaters shall be as indicated on the drawings.

2.12 Construction, Damp/Wet/Outdoor Locations

2.12.1 Enclosure type: Weather protected, type I (WPI)

2.12.2 Provide low sheath temperature space heaters in motors 50 hp and larger.

2.13 Construction, Corrosive Locations

2.13.1 Enclosure type: TEFC

2.13.2 Provide low sheath temperature space heaters in motors 50 hp and larger.

2.13.3 Motors shall meet IEEE 841.

2.13.4 Paint system to exceed the 250-hour salt fog test.

2.13.5 Paint all exterior and interior surfaces

2.13.6 All painted surfaces shall be chemical-duty epoxy finish.

2.14 TEFC Enclosures

2.14.1 The motor frame, end bracket and terminal box shall be cast iron construction.

2.14.2 The fan shall be constructed of a corrosion resistant, non-sparking material.

2.14.3 All fasteners and motor hardware shall be non-corroding.

2.14.4 Bronze breather drains shall be installed on all motors built on 254T frames or higher.

2.14.5 All interior and exterior surfaces shall have a base coat and finish coat of corrosion resistant epoxy paint.

2.15 Bearings and Lubrication

2.15.1 Provide ball bearings on all motors rated < 150 hp.

2.15.2 Provide roller bearings for motors rated 150 hp or more.

2.15.3 For belted service, bearings shall carry a “C-3” clearance classification.

2.15.4 Motors shall have a double shielded sealed bearing system, except two pole motors that may have a single shielded bearing on the drive end.

2.15.5 Motors built on larger frames shall be equipped with re-greaseable bearings.

2.15.6 The grease fittings shall be designed so that no uncoupling is necessary to perform the required maintenance.

2.15.7 Ball or roller type: Antifriction design, interchangeable, cartridge type housing preferred, with grease nipples.

2.15.8 Life expectancy: B-10 as defined by the Anti-Friction Bearing Manufacturer's Association at rated conditions of service of at least 100,000 working hours.

2.15.9 Vertical motors: Anti-friction, thrust bearings for maximum axial up and down thrusts imposed by the driven equipment. Split ring under motor hub on bottom of shaft.

2.16 Lifting Provisions

2.16.1 For motors weighing more than 20 kg, provide one or more lifting eyebolts, rings, or lugs.

2.16.2 For motors weighing more than 100 kg, provide two or more lifting eyebolts or lugs.

2.16.3 If lugs are concealed by enclosure, attach nameplates to both sides of motor warning against improper lifting.

2.17 Rotor Assembly

2.17.1 Rotation: For motors designed for single direction operation only, clearly indicate direction of rotation by means of arrow on non-driving end. Painted arrows are not acceptable.

2.17.2 Shaft extensions: With keys.

2.17.3 Keyway: NEMA standards for NEMA frame motors.

2.18 Stator

2.18.1 Windings and terminal leads: Copper conductors, with ends brought into terminal box.

2.18.2 Insulation: Moisture proof, class F minimum unless otherwise indicated.

2.18.3 Winding temperature detection

.1 For motor rated 22 kW and larger unless otherwise indicated, two type PTC thermistors per phase in the stator windings, with leads brought out to a separate terminal box, suitable for Siemens 3UN2100 tripping unit. Identify temperature sensor terminals as to phase location.

.2 For motors rated 200 kw and higher provide stator and bearing RTDs brought out to an ancillary terminal box.

.3 For submersible motors, provide a combined leak and temperature detection system (includes detectors and a MiniCAS relay with light and Reset push button)

2.19 Nameplates & Identification

2.19.1 Identify equipment in accordance with 16090.

2.19.2 Provide stainless steel nameplates showing the information required by NEMA MG-1.

2.19.3 Provide permanent identification of terminals and terminal boxes.

2.19.4 Provide permanent wiring diagrams for:

.1 All ancillary devices

.2 Winding connections

2.19.5 Motor leads shall be permanently marked in accordance with NEMA MG-1 designations

2.20 Power Factor Correction Capacitors

2.20.1 Where shown on the drawings, provide power factor correction capacitors (PFCC).

2.20.2 PFCC shall be supplied by the motor manufacturer as a package.

2.21 Manufacturers

2.21.1 Canadian General Electric

2.21.2 Etect

2.21.3 LeRoy Somers

2.21.4 U.S. Motors

2.21.5 Westinghouse

2.21.6 Toshiba

2.21.7 Baldor

2.21.8 Or, Approved Equivalent

3 EXECUTION

3.1 Installation

3.1.1 The motors shall be installed by the Contractor in accordance with the manufacturer's instructions.

3.1.2 Any slushing compound on the shaft or other parts shall be removed using a petroleum type solvent.

3.1.3 Any and all shaft shipping braces shall be removed after the motor is placed in its final location.

3.1.4 The motor shall be mounted in accordance with the manufacturer's instructions. Special care shall be taken to ensure that the motor shaft is level.

3.1.5 If a soleplate has been provided, it must be located, levelled and grouted into place following the best practices.

3.1.6 Co-ordinate with trade installing driven equipment in the alignment and coupling of motor to driven machinery. Conform to the manufacturer's instructions and ensure use of correct parts such as couplings, belts, sheaves, as provided by motor manufacturer.

3.1.7 The Contractor shall install the motor coupling in accordance with the coupling manufacturer's instruction. Under no circumstances shall the motor shaft be modified to accommodate the coupling.

3.1.8 The motor shall be aligned axially with driven equipment. This alignment shall be done in accordance with the manufacturer's instruction.

3.1.9 Make electrical connections as indicated. Install liquid-tight PVC jacketed flexible conduit section between rigid conduit feed and motor where applicable.

3.1.10 Where applicable, make flexible conduit or armoured cable long enough to permit movement of motor over entire length of slide rails.

3.1.11 All secondary wiring connections shall be made in accordance with the Contract documents and manufacturer's wiring diagrams.

3.1.12 Dry out motor in accordance with manufacturer's recommendations if dampness present.

3.2 Field Adjustments

3.2.1 The Contractor shall fill any oil reservoir with the manufacturer's specified oil.

3.2.2 If the manufacturer requires that the anti-friction bearings receive an initial change of grease, the Contractor shall perform such work.

3.2.3 The motor shaft shall be turned by hand to ensure there is free rotation.

3.2.4 For TEFC motors, the area around the external fan inlet shall be checked for loose debris that could be drawing into the fan during operation.

3.2.5 All external, factory made, bolted joints should be checked for tightness.

3.3 Field Testing

3.3.1 Review installation methods prior to energizing motor.

3.3.2 Before connecting feeder cable, measure winding insulation resistance between each phase and ground. Repeat tests after connecting feeder cable at supply. Where applicable, disconnect power factor capacitors, surge arresters and solid state equipment during test.

3.3.3 Witness final tests and provide certification that the complete installation of the motor, both mechanically and electrically, is per manufacturers recommendations.

3.3.4 Record results and include in Installation, Operations and Maintenance manual.

3.3.5 Verify operation and settings of motor protection system before energization.

3.3.6 Check motor lubrication, alignment and direction of rotation.

3.3.7 Perform motor rotation check under the supervision of the Contract Administrator and the driven equipment supplier. Uncouple motor from load where incorrect rotation is likely to damage equipment.

3.3.8 Conduct additional tests as detailed in Section 16199, Additional Inspections and Tests.

3.4 Manufacturer's Services

3.4.1 Furnish manufacturer's representative at site for installation assistance, inspection, equipment testing, and startup assistance for motors larger than 200 horsepower, unless otherwise noted.

.1 Provide manufacturer's Certificate of Proper Installation.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 The section describes the requirements for motor starters supplied under the contract as stand-alone devices or as part of an MCC or other equipment.

1.1.2 This section shall apply to starters supplied with or as part of equipment supplied by all divisions.

1.1.3 The section describes the requirements for the following types of motor starters supplied under the contract:

.1 Full-voltage, non-reversing (FVNR)

.2 Full-voltage, reversing

.3 Reduced-voltage, soft-starters (RVSS)

.4 Two-speed, single-winding starters.

1.1.4 This section describes starters with a nominal voltage of 600 V or less.

1.1.5 Refer to Section 16224 - Variable Frequency Drives to 600 V.

1.2 General

1.2.1 This section applies to starters supplied:

.1 With or as part of equipment supplied by all divisions,

.2 As stand-alone devices in enclosures, and/or

.3 For retrofit into existing enclosures.

1.2.2 Starters shall be NEMA style and listed CSA C22.2 No. 60947.

1.2.3 Starters shall consist of a disconnect means, short circuit protective device, one or more contactors and overload relays complete with the necessary control devices to achieve the functionality described on the drawings and specifications.

.1 The disconnect means and short circuit device may be a single device that performs all required functions.

1.3 Related Sections

1.3.1 Section 01330 – Submittals

1.3.2 Section 01820 – Demonstration & Training

1.3.3 Division 11 – Equipment

1.3.4 Division 13 – Instrumentation, Control and SCADA

1.3.5 Division 15 – Mechanical

1.3.6 Section 16010 – Electrical General Requirements

1.3.7 Section 16225 – Motor Control Centres

1.3.8 Section 16400 – Basic Electrical Equipment and Materials

1.3.9 Section 16671 – Surge Protective Devices

1.4 References

1.4.1 International Electro-technical Commission (IEC)

.1 IEC 947-4-1-1990, Part 4: Contactors and motor starters.

1.4.2 CSA C22.2 No. 14 Industrial Control Equipment

1.4.3 CSA C22.2 No. 60947-1 Low-Voltage Switchgear and Controlgear - Part 1: General Rules

1.4.4 CSA C22.2 No. 60947-4-1 Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-Starters - Electromechanical Contactors and Motor-Starters

1.5 Coordination

1.5.1 The contractor shall provide the starter supplier with:

.1 Details of the driven equipment

.2 Accessories supplied with the driven equipment for installation in the starter (e.g. temperature/leakage monitors for submersible pumps).

1.5.2 The Contractor shall coordinate the starter supplier and the driven equipment manufacturer to ensure that the starter and driven equipment are compatible.

1.5.3 Where the intent of control diagrams is not clear, contact the Engineer prior to submitting shop drawings.

1.6 Quality Assurance

1.6.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.

1.7 Submittals

1.7.1 Submit shop drawings in accordance with Section 01330 – Submittals.

1.7.2 Shop drawings to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout of identified internal and front panel components.

.4 Required enclosure size and ventilation requirements.

.5 Enclosure types – NEMA and/or IEC enclosure rating.

.6 Wiring diagram for each type of starter.

.7 Interconnection diagrams.

1.8 Operation and Maintenance Data

1.8.1 Provide operation and maintenance data for motor starters for incorporation into manual, specified in Section 01330 – Submittals.

1.8.2 Include operation and maintenance data for each type and style of starter.

1.9 Training

1.9.1 Provide operation and maintenance data for motor starters for incorporation into manual, specified in Section 01810 – Testing and Commissioning.

1.9.2 Include operation and maintenance data for each type and style of starter.

1.10 Maintenance Materials

1.10.1 Provide maintenance materials in accordance with Section 01810 – Testing and Commissioning.

1.10.2 Provide listed spare parts for each different size and type of starter:

.1 Contacts, stationary.

.2 Contacts, movable.

.1 1 contact, auxiliary.

.2 1 control transformer.

.3 1 operating coil.

.4 2 fuses.

.3 10% LED push to test type bulbs.

2 PRODUCTS

2.1 Materials

2.1.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 Enclosure

2.2.1 Supply and install the respective motor starters in the respective MCC's and/or in dedicated motor starter enclosures as indicated on the drawings.

2.2.2 Dedicated Motor Starter enclosures shall have a minimum rating of NEMA 12 unless otherwise indicated on the drawings. All dedicated motor starter enclosures shall include a front door complete with a full piano door hinge and external operating handle that is interlocked with the door to prevent live access to the motor starter interior components.

2.3 Design Criteria

2.3.1 Starters shall be sized and suitable for the supplied equipment.

.1 The ratings shown on the drawings are nominal only. The supplier shall select input protective devices (e.g. motor circuit protectors), contactors and overload devices to suit the as-supplied driven equipment and the application as described in the contract documents.

2.3.2 Contactors shall break all poles simultaneously.

2.3.3 All starters shall be lockable in the off position.

2.3.4 All starters shall have type 2 coordination per IEC 947.

2.3.5 Provide auxiliary contactor and overload contacts where indicated on drawings or required by application.

2.3.6 Incoming line terminals shall be shielded to provide operator protection level of IP20.

2.3.7 Starters shall be suitable for operation at full motor load including service factor at ambient temperatures between -5°C and 50°C.

2.4 Operator Interface, All Starters

2.4.1 All starter functions shall be operable from the exterior of the enclosure unless otherwise indicated. At a minimum, provide the following controls:

.1 Start/Stop control

.2 Overload reset

.3 Open/close of the disconnect switch of breaker.

2.4.2 Provide the following visual indications on the enclosure exterior unless otherwise indicated:

.1 Running

.2 Overload.

2.5 Manual Motor Starters

2.5.1 Provide single or three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Quick make, quick break switching mechanism using a stored energy mechanism. The make/break action shall not be reliant on the speed of the operating handle.

.2 Three overload heaters, manual reset, trip indicating handle.

.3 Class 10 overload.

.4 Fixed short circuit trip.

.5 Adjustable motor overload.

.6 Screw terminals for line and load side.

2.5.2 Accessories:

.1 Selector switch and/or push button: heavy duty/oil tight labelled as indicated.

.2 Indicating light: oil tight type and colour as indicated. (LED push to test type).

.3 Locking tab to permit padlocking in “ON” or “OFF” position.

2.6 Full Voltage Starters

2.6.1 Provide starters of the Full Voltage (FV) type as specified and shown on the drawings.

2.6.2 Provide NEMA starter size to suit the electrical name plate data of the respective motor application.

2.6.3 Each starter shall be provided with a control transformer, 600V, fused, primary connections phase to phase and 115V secondary shall be grounded on X2 secondary side and a suitable control circuit fuse provided on the other side.

2.6.4 Control power transformers shall be adequately rated to carry continuously the control circuit burdens and intermittently, the inrush currents imposed by the contactor coil.

2.6.5 One (1) side of coil shall be connected to the grounded side of the C.P.T. secondary.

2.6.6 Provide a minimum of two (2) normally open and two (2) normally closed auxiliary contacts for control and interlocking.

2.6.7 Each starter shall be provided with a cover mounted red indicating light which is visible with the door closed to indicate when the motor is running.

2.6.8 Provide heavy duty, oil tight pushbuttons or selector switches on the covers of those starters as indicated on the drawings.

2.6.9 Each motor starter and unit compartment shall be provided with flange formed doors with concealed hinges, and large captive screws for fastening in closed position.

2.6.10 All starters shall be closed transition type and designed for front access. Each starter shall be provided with a cover mounted red indicating light which is visible with the door closed to indicate when the motor is running, and a green indicating light when motor is not running. Provide heavy duty oil tight pushbutton, or selector stations in the covers of those starters as indicated on the drawings. Each motor starter and unit compartment shall be provided with flange formed doors with concealed hinges, and large captive screws for fastening in closed position. Starters shall be capable of being removed from a section for maintenance without the need of disconnecting power to any or complete MCC. Motor starters of EEMAC size No. 5 and smaller shall be connected to vertical bus by means of “stab-on” connectors providing a positive tin-plated contacts with both sides of the bus at all times and shall be easily removable from the unit compartment and readily interchangeable with other starters of same size. Means shall be provided in the stationary structure for supporting and aligning starter units during their removal or replacement.

2.6.11 Provide all control wiring, interlocking, auxiliary contacts, timers, double voltage relays or Ontario Electrical Safety Code approved Mylar barriers called for on the drawings or required for proper operation. Each terminal block shall be isolated to permit working on any section with MCC with the remainder of MCC energized. Terminal blocks and terminals shall be numbered and clearly identified.

2.7 Reversing Starters

2.7.1 Reversing starters shall consist of two contactors and one overload.

2.7.2 Reversing starters shall be mechanically and electrically interlocked to prevent closing both contactors simultaneously.

2.7.3 Contactors shall meet the requirements for full-voltage, non-reversing starters and shall also:

.1 Be rated for plugging duty.

2.8 Two-Speed Starters

2.8.1 Provide two contactors and two overloads.

.1 Contactors shall meet the requirements for full-voltage, non-reversing starters.

2.8.2 All starters shall be closed transition type.

2.9 Reduced Voltage Soft Starters

2.9.1 Provide reduced-voltage, soft starters (RVSS) where shown on the drawings and/or in the specifications.

2.9.2 RVSS shall employ SCRs to provide controlled starting and stopping of motors.

.1 SCRs shall be rated for a minimum peak inverse voltage rating of 1600 volts PIV.

.2 Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt effects.

2.9.3 Where units require fans to maintain starter temperatures within allowable limits:

.1 Run fans only when required.

.2 Monitor the temperatures that the fans must control

.3 Monitor fans and alarm on failure.

.4 Provide spare fan assembly.

2.9.4 The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally-coated logic boards.

2.9.5 Provide integrated, bypass contacts.

.1 The bypass contactor shall energize when the motor reaches approximately full speed

.2 Contacts shall be rated to close/open under locked rotor current.

2.9.6 Provide surge protective devices ahead of the RVSS where the starter is:

.1 In an MCC that does not have an SPD, or

.2 In an outdoor panel.

2.9.7 Provide capacitor contactors for switching in motor power factor correction capacitors once motor is up to speed.

.1 Capacitor contactors shall be suitably rated for capacitor switching.

.2 Select contactors to provide number of operations not less than the rated operations of the starter.

2.9.8 The starter shall be capable of the following soft-starting modes, all with adjustable kick start current limits:

.1 Constant current

.2 Linear acceleration

.3 ‘S’ or pump curve acceleration

2.9.9 Provide electronic overload relay with the following protection features:

.1 Motor overload based on current sampling and using inverse-time curve

.2 Supply voltage phase rotation

.3 Undervoltage on any supply phase.

.4 Current imbalance

.5 Motor thermal switch/thermistor or RTD protection where shown on the drawings/specifications

.6 Motor stall (during starting)

.7 Motor jam (running at speed)

.8 Overtemperature of the power electronics

2.9.10 Starter shall be capable of either an automatic or manual reset after a fault.

2.9.11 Provide the following form ‘C’ digital output contacts for:

.1 Fault

.2 Up-to-speed

.3 Contacts shall be rated 240V AC and 24V DC max, 3 amps as standard

2.9.12 Provide a human-machine interface on the device keypad to indicate:

.1 Current device status (ready, faulted, running, etc.)

.2 Current operating parameters (voltages, currents, temperature of the electronics, etc.)

.3 Type of fault (Overtemp, Phase Loss, Jam, Stall, Phase Reversal, and Overload).

2.9.13 The starter shall be capable of the following adjustments:

.1 Overload protection: 30 to 125% of the motor full load current

.2 Overload class: 5, 10, 20 or 30

.3 Selectable Torque Ramp Start or Current Limit Start

.4 Adjustable Kick Start Time: 0-2 seconds

.5 Adjustable Kick Start Torque: 0-85%

.6 Adjustable Ramp Start Time: 0.5-180 second

.7 Adjustable Initial Starting Ramp Torque: 0-85%

.8 Adjustable Ramp Stop Time: 0-60 seconds

2.9.14 Where adjustments are made via computer software, provide one programming cable and one copy of the software.

2.9.15 Supply RVSS with motor circuit protector for short circuit protection and quick disconnect means.

2.9.16 Acceptable Products:

.1 Eaton S801/S811

.2 Rockwell SMC Flex

.3 ABB PSTB

.4 Or, Agency Approved Equal

2.10 Control Power

2.10.1 Provide a dedicated, single phase, dry type, control transformer for each starter.

.1 Size control transformer for control circuit load plus 50% spare capacity.

.2 Secondary voltage shall be 120 VAC unless otherwise indicated.

2.10.2 Provide primary protection as follows:

.1 Fuses where the primary voltage exceeds 240 VAC L-G

.2 Circuit breakers where the primary voltage is 240 VAC L-G or less

2.10.3 Provide miniature circuit breaker on CPT secondary.

.1 Circuit breaker shall be CSA C22.2 No. 5 listed.

2.10.4 Ground the neutral of the secondary.

2.11 Control Circuits

2.11.1 Design complete control circuit to provide control logic described in the drawings or specifications.

2.11.2 Incorporate all features and systems required by the supplied components and driven equipment and by code.

2.11.3 Control circuits show only elementary circuit devices to convey the design intent. The supplier shall complete the design with all components necessary for the complete, safe operation including all customarily supplied portions of the control circuit (e.g. anti-pumping mechanisms).

2.11.4 Provide miniature circuit breakers or supplementary protectors for device protection. Do not use fuses.

2.11.5 Provide feed-through type, surge protective devices as described in 16671 for all control circuits with solid state components and all circuits with connections to SCADA.

2.11.6 Do not switch the neutral side of load devices unless required by design.

2.11.7 Refer to 16050 for pilot devices and operator control requirements.

2.11.8 E-stops shall directly remove power from electrically held contactors or shall act through safety relays.

2.12 Overloads

2.12.1 Unless otherwise indicated, provide bimetallic and electronic overloads as follows:

.1 Motors < 10 hp: bi-metallic overloads

.2 Motors 10 hp and up: electronic overloads

2.12.2 Connect overloads directly to contactors.

2.12.3 Bimetalic overloads shall have the following features:

.1 Interchangeable, adjustable heaters

.1 Class 10 unless otherwise indicated

.2 Minimum 1 N.O + 1 N.C., electrically-isolated, auxiliary contacts.

.3 Ambient compensated

.4 Manual reset, accessible from the exterior of the enclosure

2.12.4 Electronic overloads shall have the following features:

.1 Self-powered

.2 The following protection settings:

.1 Overload - Selectable class 10 or 20

.2 Voltage/Current Phase Imbalance

.3 Loss of Phase

.4 Ground Fault

.3 In addition, for motors over 100 hp, provide:

.1 Mechanical jam protection: 1.5 – 4 x FLA

.2 Adjustable Current imbalance: 5-25%

.3 Adjustable ground fault:

.4 Adjustable number of automatic resets

.4 For all motors coupled to moving machinery such as conveyors or equipment with frangible connections in the moving components, provide adjustable mechanical jam protection in the overload relay.

.1 Set the mechanical jam to operate before the physical frangible connections fail.

.2 The mechanical jam setting shall not interfere with the ability of a machine to reverse direction to clear jams.

.5 Minimum 1 N.O + 1 N.C., electrically-isolated, auxiliary contacts

.6 Ambient compensated over an operating range of 0 °C to +50 °C

.7 Impulse withstand: 6 kV on the power and control terminals.

.8 IP20 rated terminal blocks

.9 Manual reset, accessible from the exterior of the enclosure

2.13 Motor Management Relays

2.13.1 Provide motor management relays and remote temperature sensors where shown on the drawings.

2.13.2 Where a specific relay is shown on the drawings, no alternates will be considered.

2.14 Spares

2.14.1 Provide listed spare parts for each different size and type of starter:

.1 Contacts, stationary.

.2 Contacts, movable.

.1 1 contact, auxiliary.

.2 1 control transformer.

.3 1 operating coil.

.4 2 fuses.

.3 10% LED push to test type bulbs.

2.15 Enclosure Ratings

2.15.1 Indoor and dry locations: NEMA 12 unless otherwise noted

2.15.2 Corrosive locations: NEMA 4X unless otherwise noted

2.15.3 Below grade, damp or outdoor locations: NEMA 4X or NEMA 3R, as noted on contract drawings.

2.16 Equipment Identification

2.16.1 Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.

2.16.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

2.16.3 Magnetic starter designation label, white plate, black letters, size 2, engraved as indicated.

2.17 Finishes

2.17.1 Apply finishes to enclosure in accordance with Section 16010 – Electrical General Requirements.

3 EXECUTION

3.1 Installation

3.1.1 Install starters, connect power and control as indicated.

3.1.2 Ensure correct fuses and overload devices elements installed.

3.2 Field Quality Control

3.2.1 Perform tests in accordance with Section 16010 – Electrical General Requirements and manufacturer's instructions.

3.2.2 Operate switches, contactors to verify correct functioning.

3.2.3 Coordinate testing and verification to suit HVAC applications.

3.2.4 Perform starting and stopping sequences of contactors and relays.

3.2.5 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.2.6 Provide a detailed documentation of all Soft Starter configuration settings to the Contract Administrator prior to commissioning.

3.3 Factory Testing

3.3.1 The Engineer and the Owner reserve the right to witness factory testing for all reduced-voltage soft starters greater than 100 hp, at the manufacturer's factory. Provide copies of the factory test procedures and notification of the test to the Engineer and the Owner six weeks in advance of the testing.

3.3.2 Provide electronic copies of the certified test results for all stand-alone starters prior to arrival of equipment at site.

3.4 Shipping, Handling and Storage

3.4.1 Ship in accordance with manufacturer's instructions.

3.4.2 Protect from impact shock, vibration and moisture.

.1 Install drop and humidity detectors prior to shipment to MCC manufacturer.

.2 Equipment with activated detectors shall not be unloaded at the job site and shall be returned to the supplier's facilities for investigation and disposition.

.3 Do not remove detectors without the contract administrator's approval.

3.5 Preparation for Installation

3.5.1 Installation locations for indoor equipment shall be dry and heated prior to installation.

3.6 Site Acceptance Testing

3.6.1 Perform tests in accordance with Section 16010 – Electrical General Requirements and manufacturer's instructions.

3.6.2 Operate switches, contactors to verify correct functioning.

3.6.3 Coordinate testing and verification to suit Process and HVAC applications.

3.6.4 Perform starting and stopping sequences of contactors and relays.

3.6.5 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.6.6 Provide a detailed documentation of all Starter configuration settings to the Contract Administrator prior to commissioning.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 The section describes the requirements for variable frequency drives (VFDs) supplied under the contract. For example, packaged equipment.

1.1.2 This section shall apply to VFDs supplied with or as part of equipment supplied by all divisions.

1.1.3 This section is intended to be supporting document for VFD motor starters provided under other sections.

1.2 Related Sections

1.2.1 Section 16010 – General Requirements

1.2.2 Section 16225 – Motor Control Centre

1.3 References

1.3.1 IEEE 519

1.4 Product Data

1.4.1 Submit shop drawings in accordance with Section 01330 – Submittal Procedures.

1.4.2 Indicate:

.1 Power circuit schematic

.2 Control/Operator

.3 Detail parameter settings to suit the specific application for each motor.

.4 Layout of identified internal and front panel components

.5 Enclosure types

.6 Product specifications

.7 Efficiency

.8 Typical efficiency versus speed graph for variable or constant torque load as required.

.9 Compliance to IEEE 519 – Harmonic analysis for particular jobsite including total voltage harmonic distortion and total current distortion

.1 The VFD Drive manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than five per cent.

.2 Prior to installation, the VFD Drive manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VFD Drive's. The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power provider and the user.

.3 Supply a harmonic line filter to suit. All VFD's rated greater than 20hp.

.4 Acceptable products

.1 Mirus Filters – Lineator or Approved Equivalent.

1.5 Maintenance Data

1.5.1 Provide operation and maintenance data for incorporation into manual specified in Section 01780 – Closeout Submittals.

1.5.2 Include installation, programming, operation, and maintenance manuals.

1.6 General

1.6.1 Each variable frequency drive system shall be appropriately sized for the load requirements and contained in its own enclosure complete with circuit breaker, digital keypad, necessary control devices etc. Each VFD shall be suitable for double lugging of power cable.

1.6.2 The VFD Drive manufacturing facility shall be ISO 9001 certified. The VFD Drive shall be listed, Canadian UL listed or CSA listed.

.1 All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD Drive. The VFD Drive shall then be subjected to a preliminary functional test, minimum four hour burn-in and computerized final test. The burn-in shall be at 40°C, at full rated load, or cycled load. Drive input power shall be continuously cycled for maximum stress and thermal variation.

1.6.3 The drive shall be designed to provide 100,000 hours mean time before failure (MTBF) when the specified preventive maintenance is performed.

1.6.4 The digital keypad shall be used to serve as a control and diagnostic station permitting authorized operators to examine all or reconfigure vital parameters pertaining to the VFD. The fault retention memory capability shall be provided.

1.6.5 Each drive shall be designed so as not to generate any harmonics that would impair the normal operation of other equipment. The VFD supplier shall be responsible to correct any harmonics generated by the operation of his equipment. The Contractor shall be responsible to correct any problem that is caused by the distortion level resulting in causing interference with other equipment.

1.6.6 Each drive shall be designed to protect itself from any harmonics induced by the operation of other equipment.

1.6.7 The variable frequency drive shall not cause line side voltage spikes which exceed the envelope of the line voltage waveform by 10 per cent under continuous steady state conditions.

1.6.8 It is the Contractors responsibility to refer to the electrical and control schematics to provide the complete working system as shown on the drawings and specified herein irrespective of whether or not the equipment is shown or mentioned on the drawings and specifications respectively. In the event of conflicting information, the Contractor shall advise the Engineer prior to submission of tender price.

1.6.9 Active front End VFD products are acceptable to meet the requirements of the IEEE 519. VFD products that are based on active front end technology are not required to include a universal harmonic input filter.

2 PRODUCTS

2.1 Description

2.1.1 The drive shall be an open loop voltage source type, with sinusoidal Pulse Width Modulated (PWM) output inverter control, suitable for use with standard or high efficiency squirrel cage induction motors.

2.1.2 The drive shall be a direct torque control (DTC) AC to AC converter utilizing isolated gate bipolar transistor (IGBT) technology. The DTC Drive shall employ Direct Torque Control (DTC) inner loop torque control strategy that mathematically determines motor torque and flux every microsecond (40,000 times per second). The drive must also provide an optional operational mode for scalar or V/Hz operation.

2.1.3 Rating

.1 The DTC Drive shall be rated to operate from three phase power at 380V AC to 690V AC +5/-10 per cent and 48Hz to 63Hz. The DTC Drive shall employ a full wave rectifier to prevent input line notching and operate at a fundamental input power factor of 0.98 at all speeds and loads. The DTC Drive efficiency shall be 97 per cent or better at full speed and load. An internally mounted line reactor shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emissions.

.2 Output voltage and current ratings shall match the adjustable frequency operating requirements of standard 575VAC, three-phase, 60Hz, NEMA design B motors. The overload current capacity shall be 150 per cent of rated current for one minute out of 10 minutes and 200 per cent for two seconds out the 15 seconds with an instantaneous overcurrent trip at 350 per cent or higher. Output frequency shall be adjustable between 0Hz and 300Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high speed operation. The drive's switching pattern shall be continually adjusted to provide optimum motor flux and avoid the high-pitched audible noise produced by motors energized by conventional PWM drive from AC line transients.

2.1.4 Power Quality

.1 All VFDs with an output rating of 25 HP or lower shall be supplied complete with Hammond Power Solutions Centurion R series or MTE three phase input line reactors or approved equivalent, to provide line transient voltage protection. The impedance rating shall be not less than five percent.

.2 All VFD's with an output rating of 30 HP or higher shall be equipped with MIRUS International Inc. LINEATOR™ Universal Harmonic Filter (UHF), MTE Matrix Series D

Filter or approved equivalent to reduce total harmonic current and voltage distortion to the limits specified by Standard IEEE 519 1992 at the input terminals of the harmonic filters. Input line reactors are not acceptable.

.3 Provide separate lightning protection and surge arrester for VFDs located outdoors or on roof tops of outdoor structures.

2.1.5 The drive shall be designed to facilitate testing while the drive is operating as well as when the drive disconnect switch is de-energized (with auxiliary control power applied). In addition, the drive shall be capable of operation without a motor connected, for set-up and testing purposes.

2.1.6 Provide an input non-automatic circuit breaker with a door interlock mechanism capable of being padlocked in the open position. In addition, provide input line fuses whose characteristics are coordinated with the drive's electronic protection circuits, so as not to blow under normal output faults.

2.1.7 Size the drive to satisfy the pump output and speed requirements at the design and run out conditions at a maximum of 90 per cent of the drive rating, and in any event shall not be less than the full load electric current rating of the respective motor controlled. Provide the variable frequency controller to convert the input three phase fixed voltage (600 volts) and fixed frequency (60Hz) into an output of adjustable voltage and frequency. Provide the output to the induction motor be 0-575 volt, three-phase, 6-66 Hertz (No transformers)The drive shall be provided with an output capable of operating each motor and pump over the entire speed range of 10-100 per cent at high torque conditions.

2.1.8 Operator Control Panel

.1 Each DTC Drive shall be equipped with a front mounted operator control panel consisting of a four line by 20 character backlit alphanumeric display and a keypad with keys for Run/Stop, Local/Remote, Increase/Decrease, menu navigation and parameter select/save. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross reference table. A display contrast adjustment shall be provided to optimise viewing at any angle.

.2 During normal operation, one line of the control panel shall display the speed reference, and Run/Stop Forward/Reverse and Local/Remote status. The remaining three lines of the display shall be programmable to display the values of any three operating parameters. At least 26 selections shall be available including the following:

.1 Speed/Torque in per cent, RPM or user scaled units

.2 Output frequency, voltage, current and torque

.3 Input voltage, power and kilowatt hours

.4 Heat sink temperature and DC bus voltage

.5 Status of discrete inputs and outputs

.6 Values of analogue input and output signals

.7 Values of PID controller reference, feedback and error signals

.8 Control interface inputs and outputs shall include:

.1 Three analogue inputs, one 0VAC – 10VAC and two 4mA – 20mA, all independently programmable with at least 10 input function selections. A differential input isolation amplifier shall be provided for each input. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. Upon loss of input signal, the drive shall be programmable to stop and display a fault message, run at a preset speed and display a warning message or display a warning message and run according to the last reference received.

.2 Six discrete inputs, all independently programmable with at least 25 input function selections. Inputs shall be designed for “dry contact” inputs used with either an internal or external 24VDC source.

.3 Two analogue outputs providing 4mA to 20mA signals. Outputs shall be independently programmable to provide signals proportional to at least 12 function selections including output speed, frequency, voltage, current and power.

.4 Provide the drive suitable to accept a remote 4-20mA DC signal for speed control.

.5 Three form C relay contact outputs, all independently programmable with at least 30 output function selections. Relay contacts shall be rated to switch 8 Amps at 24VDC or 250VAC. Function selections shall include indications that the drive is ready, running, reversed and at set Speed/Torque. General and specific warning and fault indications shall be available. Adjustable supervision limit indications shall be available to indicate programmed values of operating speed, speed reference, current, torque and PID feedback.

2.2 Communications

2.2.1 Serial communication interface modules shall be available for Devicenet and MODBUS. Communications modules shall be connected to the drive by fiber optic cables. A fiber optic communication port shall also be provided for personal computer interface. Microsoft© Windows based software shall be available for drive setup, diagnostic analysis, monitoring and control. The software shall provide real time graphical displays of drive performance.

2.2.2 Supply all communication modules to suit.

2.3 Environment

2.3.1 Ambient operating temperature: 0°C to 40°C

2.3.2 Humidity: 0 to 90 per cent non-condensing

2.3.3 Altitude less than 1,000 meters above sea level

2.4 Construction

2.4.1 Provide drives in MCC cubicles or wall-mount enclosure as shown on the drawing.

2.4.2 Drives mounted in MCCs:

.1 The drive and associated filters and controls shall be housed in an MCC cubicle complete with ventilated front panels.

.2 Cubicle exterior colour shall match the MCC. All back/side interior panels shall be enamel white.

.3 Ventilation openings shall be fitted with dust filters. Filters shall be replaceable from the exterior only.

.4 VFDs mounted in MCCs supplied under the contract shall be mounted by the MCC manufacturer in the factory.

2.4.3 Wall-mounted drives

.1 Provide a wall mount VFD to suit applications where indicated on the design drawings. Wall mounted applications to be installed in NEMA 12 enclosures unless otherwise specified on the drawings.

.2 Paint colour shall be ASA 61 grey.

.3 Top entry conduits/cables shall not be accepted. Adequate spacing must be provided between power and control cable entry/exit points. Sufficient room shall be provided within the drive enclosure, to ensure external wiring is not obstructed by or in contact with power or control devices.

2.4.4 The main control circuit board shall be securely mounted on the back of the enclosure door, and shall be easily accessible without the potential for contact with power circuit components.

2.4.5 All external connections to the drive shall be terminated in suitably rated and clearly identified terminals/terminal blocks.

2.4.6 All control wiring shall be identified with heat-shrink type wire number markers.

2.5 Performance

2.5.1 Input voltage: 600VAC ± 10 per cent, three-phase, three wires

2.5.2 Input frequency: 60Hz ± 5 per cent

2.5.3 Input power factor: > 0.95 over the operating speed range

2.5.4 Output frequency range: 0-60Hz ± 0.5 per cent, minimum frequency and maximum frequency independently adjustable

2.5.5 Power factor: 0.95 or better at any speed or load

2.5.6 Output Volts/Hertz ratio: Constant and suitable for 575VAC/60Hz motors, with adjustable voltage boost

2.5.7 Output harmonics: < 5 per cent FLA (RMS)

2.5.8 Acceleration rate: adjustable

2.5.9 Deceleration rate: adjustable

2.5.10 Overload capacity: 115 per cent FLA continuous

2.5.11 Current limit: adjustable

2.5.12 Drive control efficiency at rated load and frequency: 98 per cent or better

2.5.13 The drive shall not be affected by the frequency shifts encountered when line starting other loads with generator power.

2.5.14 The drive operation shall not be affected by 100 per cent line notching of a duration less than or equal to 100 milliseconds.

2.5.15 The output frequency regulation shall not be greater than 1.0 per cent.

2.5.16 The output V/Hz regulation shall not be greater than ± 10 per cent.

2.5.17 The output current waveform shall be close to a sine wave so that the motor rating, including service factor, is not reduced by more than 5 per cent.

2.5.18 The drive shall withstand, without any damage, the following conditions:

.1 Phase to phase output short circuit

.2 Phase to ground output short circuit without isolation transformers

.3 The application of a stationary, reverse or forward rotating motor while the drive is starting or while inadvertently running on open circuit.

2.5.19 The drive shall be designed to avoid the following conditions:

.1 A premature breakdown of the motor insulation

.2 Unacceptable motor temperature rise over the entire speed range

2.5.20 The drive shall be deigned to operate a motor that is connected to the drive with conductors (in conduit or raceway) or RX cable up to 100 metres long.

2.5.21 The drive shall be designed such that it will shut down without damage under the following conditions (unless otherwise specified and documented by the drive manufacturer):

.1 Low AV input voltage. Indirect sensing of line voltage via the DC bus is not acceptable.

.2 Missing AC bus voltage

.3 Over-voltage DC bus voltage

.4 Under-voltage DC bus voltage

.5 High peak DC bus and/or output current

2.6 Rating

2.6.1 Drive to be rated as indicated on drawings.

2.7 Protection Features

2.7.1 Design the drive to shutdown without damage, under the following conditions:

.1 Ground fault trip (the fault current level shall be adjustable)

.2 Instantaneous output over-current

.3 DC over-voltage

.4 DC under-voltage

.5 Heat sink over-temperature

.6 Output overload (electronic)

.7 Motor overload (thermal)

.8 Input fuse fault

.9 Input over-current

.10 Incorrect input phase sequence

.11 Input over-voltage

2.7.2 For each programmed warning and fault protection function, the drive shall display a message in complete English words or English abbreviations. The five most recent fault messages and times shall be stored in the drive's fault history.

2.7.3 The drive shall include MOV's for phase to phase to ground line voltage transient protection.

2.7.4 Output short circuit and ground fault protection rated for 42,000 amps shall be provided without relying online fuses. Motor phase loss protection shall be provided.

2.7.5 The drive shall provide electronic motor overload protection qualified per EEMAC Class 10 and Class 20 requirements.

2.7.6 Protection shall be provided for AC line or DC bus over-voltage at 130 per cent of maximum rated or under-voltage at 65 per cent of minimum rated and input phase loss.

2.7.7 A power loss ride through feature will allow the drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

2.7.8 Stall protection shall be programmable to provide a warning or stop the drive after the motor has operated above a programmed torque level for a programmed time limit.

2.7.9 Under load protection shall be programmable to provide a warning or stop the drive after the motor has operated below a selected under-load curve for a programmed time limit.

2.7.10 Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.

2.7.11 Input terminals shall be provided for connecting a motor thermistor (PTC type) to the drive's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact.

2.8 OPERATING AND CONTROL FEATURES

2.8.1 Provide automatic reset and restart on the first drive fault, the restart being initiated only if the start command is maintained. Should a second drive fault occur within an adjustable time window after the first, the drive shall be locked out and require a manual or remote reset. This feature can be defeated if first fault auto restart is not required.

2.8.2 Start-up data entries shall include motor nameplate power, speed, voltage, frequency and current.

2.8.3 A motor parameter ID function shall automatically define the motor equivalent circuit used by the sensor-less vector torque controller.

2.8.4 Control of the drive shall be possible at the drive panel (Panel Mode with control via start, stop and reset pushbuttons and a speed potentiometer) or externally via a start/stop and reset contacts and 4-20mA speed command (External Auto Mode). The selection of the operating mode shall be done by control switches on the drive's operator control panel.

2.8.5 Provide signal isolation and scaling/offset adjustments for the external 4-20mA and potentiometer speed commands.

2.8.6 Provide a diagnostic LED panel which displays system status information (i.e.: External Auto Mode, Power On, Ready, Run, Fault etc.), each individual fault status and indication of first fault reset and current limit operation.

2.8.7 Provide for two external permissive interlock or E-Stop normally closed contacts.

2.8.8 Provide for one normally closed external system fault contact input.

2.8.9 Provide metering on the drive operator control panel for motor frequency (or speed), current and voltage.

2.8.10 Provide the following signals for remote monitoring:

.1 Form C contacts for indicating the Ready, Run and Fault status. Note these status signals must be mutually exclusive (i.e.: only one is active at any time) and the fault status must be failsafe.

.2 A status contact to indicate selection of the External Auto Mode

.3 An isolated 4-20mA signal proportional to 1-100 per cent frequency

2.9 ACCEPTABLE SUPPLIERS

2.9.1 Eaton PowerXL DG1

2.9.2 Allen Bradley Powerflex 700

2.9.3 ABB ACS 800

2.9.4 Or, Approved Equivalent

3 EXECUTION

3.1 INSTALLATION

3.1.1 Install wall mounted VFD's as indicated on the drawings.

3.1.2 Connect power and control as indicated. Ensure correct fuses and overload devices elements are installed.

3.1.3 Coordinate installation of input line reactors.

3.2 FIELD QUALITY CONTROL

3.2.1 Perform tests in accordance with Section 16010 – General Requirements and manufacturer's instructions of each VFD.

3.2.2 Operate switches, contactors to verify correct functioning.

3.2.3 Perform starting and stopping sequences of contactors and relays.

3.2.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 COMMISSIONING

3.3.1 The Variable Frequency Drive supplier shall provide the services of a factory representative on site for the purpose of start-up, tuning, calibration and commissioning.

3.3.2 Provision to be made for a period of demonstration and training as specified in Section 01820 – Demonstration and Training

3.3.3 To be coordinated with pump/motor supplier being on site at the same time

3.3.4 The factory representative shall be technically competent in all aspects of the drive being supplied.

3.3.5 The factory representation shall be a direct employee of the drive manufacturer.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section covers the supply and installation of motor control centres (MCC).

1.2 Scope

1.2.1 Provide new MCCs as shown on the drawings.

1.2.2 Provide SPDs for the new MCC in accordance with 16671 – Surge Protective Devices.

1.2.3 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

1.3 Coordination

1.3.1 The MCC is to be installed in a building with limited space. The MCC is not permitted to exceed the dimensions identified on the drawings. MCC shop drawings that are submitted with dimensions that exceed the dimensions shown on the drawings will be rejected.

1.3.2 Dimensional Restrictions: Layout dimensions will vary between manufacturers. The Supplier shall coordinate with the Contractor to facilitate a proper installation, subject to acceptance by Engineer.

1.3.3 The installing Contractor shall verify that the equipment proposed shall fit into the available space. Coordinate installation with other trades and notify the approval authorities of any interferences or conflicts in the MCC system power and control wiring.

1.4 Related Sections

1.4.1 Section 16010 – Electrical General Requirements

1.4.2 Section 16090 – Equipment Identification

1.4.3 Section 16223 – Motor Starters to 600V

1.4.4 Section 16224 – Variable Frequency Drives to 600V

1.4.5 Section 16412 – Moulded Case Circuit Breakers

1.4.6 Section 16671 – Surge Protective Devices

1.4.7 Division 1 – General Requirements

1.5 Applicable Codes and Standards

1.5.1 All equipment furnished under this section shall be designed, constructed and tested in accordance with current versions of the applicable standards of ANSI, CSA, EEMAC, IEEE, NEMA, and the OESC including, but not limited to NEMA ICS 2-322.

1.5.2 Reference to standards and organizations in the Specifications shall be by the following abbreviated letter designations:

.1 CEA Canadian Electricity Association

.2 CSA Canadian Standard Association

.3 IEEE Institute of Electrical and Electronic Engineers

.4 IEC International Electro Technical Commission

.5 NEMA National Electrical Manufacturers Association

.6 EEMAC Electrical and Electronic Manufacturers Association of Canada

.7 ISO International Organization for Standardization

.8 NFPA National Fire Prevention Association

.9 ULC Underwriters Laboratory Canada

1.6 General

1.6.1 The MCC shall be provided with main disconnect circuit breakers, tie breaker, surge protection devices, power monitoring and branch and feeder circuit breakers as indicated on the drawings and as specified herein.

1.6.2 Provide the necessary shipping splits to ensure that the MCC may be installed in the new building through the access doors.

1.6.3 The short circuit & protection coordination study shop drawing is to be submitted prior to the submission of the MCC electrical distribution equipment shop drawings. Confirm that the available fault contribution does not exceed the rating of the MCC or any of its distribution components.

1.6.4 Equipment furnished under this section shall be fabricated, assembled, tested, and shipped to the job site in full conformity with the instructions and recommendations of the equipment manufacturer, unless Engineer notes exceptions.

1.6.5 Nameplates: The MCC will include a larger nameplate for the MCC's name, including both sides of a main-tie-main setup. Each hinged door shall be provided with a nameplate giving the units description. Each control or indicating device mounted on the face of each door shall be provided with a nameplate giving its designation. Each control device and each control wire terminal block connection inside each unit shall be identified with nameplates or painted legends to match the identification on the manufacturer's wiring diagrams. Unit nameplates for circuit breakers, motor starters and contactors shall indicate the equipment being controlled and the operating voltage and phase. Nameplates will include the powered device's location on the final line. Nameplates shall be attached with self-tapping screws. Adhesive backed nameplates are not acceptable. Nameplates shall be white and black laminated phenolic material of suitable size, and shall be engraved with 10 mm high letters for compartment identity and 5 mm letters for other information. The engraving shall extend through the white exterior lamination to the black center.

1.7 Measurement & Payment

1.7.1 Section 16225 – Motor Control Centres will not be measured but will be paid for at the price included in Bids and Tenders for this section.

1.8 Quality Assurance

1.8.1 The equipment supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

1.8.2 All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field.

1.8.3 Like parts of duplicate units shall be interchangeable.

1.8.4 Equipment shall not have been in service at any time prior to delivery, except when required by tests.

1.8.5 Manufacturer to provide standard factory testing of complete motor control centre including operation of switches and circuit breakers.

1.8.6 Submit certified written test results to Engineer prior to shipment.

1.8.7 The Manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

1.8.8 For the equipment specified herein, the manufacturer shall be ISO certified.

1.8.9 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

1.9 Submittals

1.9.1 Make submittals in accordance with Section 13330 – Submittals.

1.9.2 Shop drawings shall include complete assembly, foundation and installation drawings, and include complete engineering data covering the materials used, parts, devices, and accessories forming a part of the motor control centre. The drawings and data shall include, but shall not be limited to, the following:

.1 Master Drawing Index

.2 Front View Elevation of MCC Assembly

.3 Floor Plan of MCC Assembly

.4 Top View of MCC Assembly, indicate shipping splits

.5 Location of shipping splits.

.6 Single Line Diagram showing power distribution and all major devices.

.7 Three-line diagrams showing the connections between all devices connected to the power bus.

.8 Unit Wiring Diagrams showing devices, connections and terminal designations

.9 Interconnection wiring schematics

.10 Nameplate Schedule

.11 Conduit Entry/Exit Locations

.12 Assembly Ratings including:

.1 Short-circuit rating

.2 Voltage

.3 Continuous current

.13 Major Component Ratings including:

.1 Voltage

.2 Continuous current

.3 Interrupting Ratings

.14 Cable terminal sizes.

.15 Shipping and handling instructions.

1.9.3 Where applicable the following information shall be submitted to the Engineer:

Where applicable the following information shall be submitted to the Engineer:

.1 Busway connection.

.2 Connection details between close-coupled assemblies.

.3 Composite floor plan of close-coupled assemblies.

.4 Key interlock scheme drawing and sequence of operations.

1.9.4 Upon request, provide type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing

1.9.5 Provide the following product information:

.1 Descriptive bulletins.

.2 Product sheets.

1.9.6 Spare Parts and Tools

.1 Provide a list of spare parts and tools prior to shipping the MCC.

.1 Include a price list, part numbers or designations for all spare parts/tools.

.2 Include in the list:

.1 Special tools required for commissioning

.2 Special tools required for servicing of the equipment

.3 Recommended spare parts required for routine and minor overhauls for two (2) years of normal operation.

1.10 Operation and Maintenance Data

1.10.1 Operation and maintenance manuals shall be submitted in accordance with the submittals section.

1.10.2 Operation and Maintenance manuals shall include the following:

.1 Assembly, installation, alignment, adjustment and checking instructions.

.2 Lubrication and maintenance instructions.

.3 Guide to troubleshooting.

.4 Parts lists and predicted life of parts subject to wear.

.5 Outline, cross section, and assembly drawings, engineering data and wiring diagrams.

.6 Test data and performance curves, where applicable.

.7 The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

.8 Manufacturer commissioning sheets.

1.11 Field Measurements

1.11.1 Dimensional Restrictions: Layout dimensions will vary between manufacturers. The Supplier shall coordinate with the Contractor to facilitate a proper installation, subject to acceptance by Engineer.

1.11.2 The installing Contractor to verify equipment proposed shall fit into the available space. Coordinate installation with other trades and notify the approval authorities of any interferences or conflicts in the MCC system power and control wing.

1.12 Spare Parts and Tools

1.12.1 Provide an itemized list of spare parts as recommended for start-up.

1.12.2 Provide an itemized list of all recommended spare parts required for routine and minor overhauls for two (2) years of normal operation. Each piece of equipment shall have part number or designation.

1.12.3 Use identical equipment and components where practical to permit inter-changeability of parts, minimize spare parts inventory, and to simplify maintenance.

1.12.4 Where two or more items of equipment perform similar functions, use the same make and, where practical, the same model number and size.

1.12.5 Provide a complete list with price list of special tools required for commissioning and servicing of the equipment.

1.13 Site Conditions

1.13.1 Refer to Data Sheet

2 PRODUCTS

2.1 Design Criteria

2.1.1 Each motor control centre and all of its components shall be rated for the interrupting capacity (IC) indicated on the drawings and in the data table.

2.1.2 Provide identification in accordance with section 16090

2.1.3 Provide connection to SCADA as required and indicated on drawings.

2.2 Structure

2.2.1 The motor control centre shall consist of standardized, freestanding structures bolted together to form a single completely dead-front structure.

2.2.2 Each vertical section shall be constructed of modular components of various sizes. The modular components shall be designed to accommodate not more than six Size 1 or Size 2 full voltage combination motor starters per vertical section.

2.2.3 Construction: NEMA enclosure rating as indicated on data sheet.

2.2.4 Provide drip shields and gaskets when data sheet indicates MCC as sprinkler-proof.

2.2.5 A removable lifting angle shall be mounted on the top of each shipping group.

2.2.6 Provide removable front and rear bottom channel sills that extend the full width of the motor control centre.

2.2.7 Dimensions (unless otherwise indicated on drawings)

.1 Height: 2286 mm high

.2 Section width: 500 mm minimum

.3 Depth: 533 mm

2.2.8 Each standard section shall have all necessary hardware and vertical busing for modular plug-in units to be added and moved around.

2.2.9 All unused space shall be covered by hinged blank doors and equipped to accept future units. Maximum size of blank doors shall be 300 mm.

2.2.10 Each vertical section shall have removable, bolted, rear plates. Each removable plate shall cover no more than half the height of a single vertical section.

2.2.11 Doors shall be held closed with captive, quarter-turn fasteners. Minimum two per door.

2.2.12 Isolation Barriers

.1 Individual motor starter units, feeder breaker units, transformers, lighting panels, and control device compartments shall be isolated from each other by barriers of metal or a suitable insulating material

.2 Provide automatic vertical bus shutters for each unit.

.3 Vertical metal barriers shall extend the full height and depth of the each section to isolate adjacent sections.

.4 Each unit shall have complete top and bottom steel plate for isolation between units.

.5 Vertical wireways shall be separated from the vertical and horizontal power busses.

.6 Provide labyrinth isolation barriers over buswork.

.7 Provide bolted covers at both ends of motor control centre to allow future expansion without further drilling, cutting or preparation in the field.

.8 Provide openings with removable cover plates in the side of vertical sections to allow horizontal wiring between sections.

2.2.13 Incoming Cables

.1 Incoming cables to enter at top/bottom with terminals as indicated.

.2 Provide main feeder pull box where indicated on the data sheet.

.3 Where incoming feeder connection is by bus duct, the Contractor is responsible to coordinate the entry requirements.

2.2.14 Wireways:

.1 Each vertical section shall have a vertical-wiring trough for power and control wiring, and wiring troughs on top and bottom, which are continuous through the entire control centre. Wire ties shall be provided in the vertical wireways unless the wireways are separated from the plug-in units by a permanent wall.

.2 Minimum horizontal wireway size:

.1 Vertical bus rating > 1000 A: 200 mm wide

.2 Vertical bus rating <= 1000 A: 100 mm wide

2.2.15 Vertical wireways complete with doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.1 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from bus bars by steel barriers.

.2 Minimum horizontal wireway size:

.1 Top entry cables: 300 mm top, 75 mm bottom

.2 Bottom entry or top/bottom entry cables: 225 mm top and bottom

2.2.16 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

2.2.17 Removable circuit breaker and motor starter units shall be provided with a mechanical interlock to prevent insertion or withdrawal when in the “on” position.

2.2.18 Continuous 25 mm channel iron floor sills for mounting bases with 19mm diameter holes for bolts.

2.3 Withdrawable Unit Compartments

2.3.1 Provide withdrawable compartments for starters and circuit breakers where the compartment is less than 912 mm tall.

2.3.2 Withdrawable units shall be self-disconnecting plug-in type.

2.3.3 Provide guide rail supports for units to ensure that stabs make positive contact with vertical bus.

2.3.4 Withdrawable units shall be capable of insertion or removal with main bus energized.

2.4 Compartments – General Requirements

2.4.1 Hinge all unit doors on same side.

2.4.2 Overload relays shall be manually reset from front with door closed.

2.4.3 Pushbuttons and indicating lights mounted on door front.

2.4.4 Devices and components shall be by one (1) manufacturer to facilitate maintenance.

2.4.5 Provide pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.5 Finishes

2.5.1 Shop finish metal enclosure surfaces by application of rust-resistant primer inside and outside, and at least two coats of finish enamel.

2.5.2 Paint motor control centre exterior ANSI #61 light grey and interiors semi-gloss white.

2.5.3 Provide a 100 mL container of finish enamel for touch-up on site.

2.6 Circuit Breakers

2.6.1 Provide circuit breakers as shown on the drawings and in accordance with section 16412 – Moulded Case Circuit Breakers.

2.6.2 Motor Control Centre main disconnect circuit breakers shall be three pole, single-throw, 600 volt, moulded-case breakers.

2.6.3 Circuit breakers of combination starters shall be magnetic motor circuit protector type.

2.6.4 Branch and feeder circuit breakers shall be thermal-magnetic type and shall be manually operated, with quick-make, quick-break, trip-free toggle mechanism. Bimetallic thermal elements shall withstand sustained overloads and short-circuit currents without injury and without affecting calibration. Thermal elements shall trip the breaker at 125 percent of trip rating.

2.6.5 The instantaneous elements of 225 ampere frame and larger breakers shall be adjustable and shall be set at 800 percent of trip rating.

2.6.6 Main disconnect circuit breakers and feeder circuit breakers 225 amperes and larger shall be furnished with a solid-state trip unit complete with built-in current transformers. The ampere rating of the trip unit shall be as indicated on the drawings. The trip unit shall have adjustable settings for continuous amperes, and short-time pickup. The trip unit shall be provided with additional short delay trip time adjustment for better system coordination. Where indicated on the drawings, main circuit breakers shall be provided with instantaneous pickup and integral ground fault protection with shunt trip devices.

.1 Provide ground fault protection integral to the main disconnect breaker to suit breaker applications that are frame rated 1,000 Amps or greater.

.2 All breakers shall be 100 % rated

.3 Provide visible isolation were the MCC is fed directly from a transformer with a high-voltage (>1000 V L-L) primary.

2.7 Instrumentation and Controls Devices and Wiring

2.7.1 Refer to Section 16400 – Basic Electrical Equipment and Materials for pilot devices and general control equipment specifications

2.7.2 Wiring Labels and Terminal Blocks: All internal wires shall be labelled at each termination. Terminals shall also be identified with labels showing the terminal block and terminal number.

2.7.3 Unit Control Terminal Blocks: Terminal blocks shall be pull-apart type rated 20 amperes. All current carrying parts shall be tin-plated. The removable portion of the terminal blocks shall be used for factory installed wiring.

2.7.4 NEMA MCC wiring class shall be as shown on the data sheet.

2.7.5 Control wiring shall be 105 °C Type SIS, min #14 AWG.

2.7.6 All wires shall be identified with heat-shrink, oil-resistant wire markers.

2.7.7 Identify wires, terminal blocks and other components in accordance with the control schematics.

2.7.8 Provide spade wire terminals for all control circuit wiring.

.1 Crimp all terminals with the manufacturer's recommended tool.

2.7.9 Each section requiring control power shall be equipped with a dedicated control power transformer.

2.7.10 Relays and Timers: Auxiliary relays and timers shall have 120 volt, 60 Hz coils for continuous duty in 40°C ambient, and 10 ampere, 120 volts ac contacts. Auxiliary relays shall be NEMA rated.

2.7.11 Control Switches and Pilot Lights: Control switches and pilot lights shall be heavy-duty, oil tight construction. Pilot lights shall be transformer type with LED lamps.

2.7.12 Pilot/Indicator Light

.1 All pilot/indicator lights to be LED type.

.2 All lights to be push to test type.

2.7.13 Where MCCs have multiple incoming feeders, provide mechanical and/or electrical interlocks as shown on the drawings.

2.8 Surge Protective Devices

2.8.1 Provide SPDs in accordance with the drawings and section 16671 – Surge Protective Devices.

2.9 Digital Power Metering

2.9.1 Where shown on the drawings, provide a microprocessor based digital power meter.

2.9.2 The meter shall be capable of Ethernet serial communication for remote monitoring.

2.9.3 Operating voltage: 120V AC

2.9.4 Monitoring:

.1 Voltage on each Phase.

.2 Current on each Phase.

2.9.5 Recording/Display:

.1 Frequency

.2 Power Factor

.3 KVA

.4 KW

.5 KVAR

.6 KW Demand

.7 Total MWHR

.8 Total MVARHR

.9 Total Harmonic Distortion

2.9.6 Flush mount meter on MCC front panel.

2.9.7 Display

.1 All displays shall be on an alpha-numeric vacuum fluorescent display

2.9.8 Provide a minimum of three (3) programmable control relays to function as alarm, set point or remote-control relays

2.9.9 The following alarm features shall be provided:

.1 under voltage

.2 power factor leading or lagging

.3 kVAR limit

.4 Voltage sequence reversal

.5 under frequency

.6 overcurrent

2.9.10 Key Features:

.1 Maxima and Minima readings for each of the readings available

.2 Memory to be non-volatile and shall retain all programming and stored data in the event of a power failure

2.9.11 Provide a Human Machine Interface (HMI) mounted in the door of the MCC cell for visual power status indication and programming/setup interface

2.9.12 Provide all required CT's and PT's, as required.

2.9.13 Provide CT shorting switch or test block.

2.9.14 All set points to be set in field by the Contractor as directed by the Engineer.

2.9.15 Acceptable Product:

.1 Power Measurements ION 7650

.2 GE PQM

.3 Alle n Bradley Power Monitor 5000 complete with Ethernet Communications, and LCD Display.

.4 SEL 735

.5 Or Approved Equivalent

2.10 Equipment Identification

2.10.1 Provide equipment identification in accordance with Section 16090 – Equipment Identification.

2.10.2 The Contractor shall apply Arc Flash Hazard labels in accordance with Section 16015 – Electrical Systems Analysis

2.11 Acceptable Suppliers

2.11.1 Eaton

2.11.2 Allen Bradley

2.11.3 General Electric

2.11.4 Schneider Electric - Square D

2.11.5 Or Approved Equivalent

3 EXECUTION

3.1 Examination

3.1.1 Overload relay heater ratings must be properly sized and coordinated for each motor starter unit.

3.1.2 Installing Contractor to verify ESA clearances prior to installation. Verify CSA labelling of the assembly prior to installation.

3.2 Factory Testing

3.2.1 Manufacturer to provide standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

3.2.2 The motor control centres shall have been type-tested in a high-power laboratory to prove adequate mechanical and electrical capabilities.

3.2.3 All factory tests required by the latest ANSI, NEMA and CSA standards shall be performed.

3.2.4 The manufacturer shall provide three (3) certified copies of factory test reports.

3.2.5 Factory tests as outlined above shall be witnessed by the Owner's representative.

.1 The manufacturer shall notify the Owner two (2) weeks prior to the date the tests are to be performed.

3.3 Shipping, Handling and Storage

3.3.1 Shipping, handling, and storage shall be in accordance with Division 1 requirements.

3.3.2 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

3.3.3 Ship the equipment in as few sub-assemblies as is practical and in accordance with overall erection schedule.

3.3.4 Pack, crate or otherwise protect each item so that it is not damaged in transit and arrives in serviceable condition at the site. In particular, ensure accumulation of water in equipment is prevented.

3.3.5 Include with the shipment one copy of erection drawings, instructions and maintenance manuals in English.

3.3.6 Clearly mark all crates, boxes and cartons to indicate the purchase order number and the name of the equipment.

3.3.7 Install shock/drop and humidity indicator cards on each shipping split or individual component.

.1 Equipment shall not to be offloaded at site unless the Contract Administrator has inspected each card and found them satisfactory.

.2 Indicators shall not be removed until commissioning

3.3.8 Shipping invoice shall show the crate, box or carton number.

3.4 Installation

3.4.1 Contractor to follow the installation instructions supplied by the manufacturer.

3.4.2 Control wiring shall be as shown on the contract drawings except as modified by the approval and submittal process. Interface all local and remote devices into the control wiring and operational systems for each load.

3.4.3 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

3.4.4 Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.

3.4.5 Coordinate terminal connections with installation of secondary feeders.

3.4.6 Grout mounting channels into floor or mounting pads.

3.4.7 Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.

3.4.8 Remove foreign material, including dust before energizing equipment.

3.4.9 Connect power, control and grounding wiring.

3.4.10 Prior to energization, confirm in writing that solid state devices have been activated, programmed, calibrated, and set.

3.4.11 Make grounding connections between equipment ground busses and building grounding system.

3.4.12 Check all factory made connections for mechanical security, electrical continuity and current phasing.

3.5 Manufacturer's Commissioning Services

3.5.1 Overload relay heater ratings must be properly sized and coordinated for each motor starter unit.

3.5.2 Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of five (5) working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

3.5.3 The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative:

.1 Rig the MCC assembly into final location and install on level surface.

.2 Check all removable cells and starter units for easy removal and insertion.

.3 Perform insulation tests on each phase and verify low-resistance ground connection on ground bus.

.4 Connect all power wiring and control wiring and verify basic operation of each starter from control power source.

.5 Torque all bolted connections made in the field and apply witness marks.

.6 Verify all factory bolted connections.

.7 Calibrate any solid state metering or control relays for their intended purpose and make written notations of adjustments on record drawings. Perform start-up of any solid state starters and adjustable frequency drives.

.8 Operate all equipment under load.

3.5.4 Follow the manufacturer's instructions and the contract documents concerning any Make all settings of short circuit devices settings, heater selection, timing relays, or start-up of components.

3.5.5 Generate a field report on tests performed, test values experienced, etc., and make available to Owner upon request.

3.5.6 The Contractor shall provide three (3) copies of the manufacturer's field start-up report.

3.5.7 Provide a VFD and Soft Start manufacturer's representative on site to suit the setup, programming and verification of all VFD & Soft Start motor starters for a period of four (4) non-consecutive days.

3.5.8 Provide a hard copy typed printout of all set up parameters to the Engineer for review prior to field commissioning.

3.5.9 Measure and record Full Load Amp (FLA) for all starters and feeder breakers.

3.6 Site Acceptance Tests

3.6.1 Follow the minimum requirements as stipulated in the manufacturer testing procedure for this type of motor control centre assembly.

3.7 Manufacturer's Certification

3.7.1 A qualified factory trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. Equipment shall be inspected prior to the generation of any reports.

3.7.2 The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.8 Training

3.8.1 The manufacturer shall provide training sessions and materials in accordance with section 01820 – Demonstration and Training.

3.8.2 The training session shall be conducted by a manufacturer's qualified representative.

3.8.3 The training program shall consist of the following:

.1 Review of the MCC one-line drawings and schedules.

.2 Review of the factory record shop drawings and placement of the various cells.

.3 Review of each type of starter cell, components within, control, and power wiring.

.4 Review common maintenance procedures including VFD filter replacement, bus inspection, cable termination inspection, contactor coil replacement and contact replacement procedures.

.5 Review the operation of equipment including wrapper removal and proper lock-out procedure.

.6 Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.

3.9 Data Sheets

3.10 MCC - 0001

Name	**MCC-0001**	**Location**	**Martin St.**
Environment	Indoor	Min. Ambient Temp.	+15ºC
Site Elevation (asl)	<1000 m ASL	Max. Ambient Temp.	+40ºC
Known Contaminants	None		
Supply Voltage	600 V	Structure	NEMA 1
Supply Arrangement	3 ph, 3 wire.	Colour	ANSI 61
Main Bus Ampacity	400 A	Sprinkler-proof	No
Vertical Bus Ampacity	300 A	Wiring Class	1B
Neutral Bus Ampacity	n/a	Space Heaters	No
Ground Bus Ampacity	300 A	Bus Material	TIN PLATTED COPPER
Bus Temperature Rise	65 °C	Horizontal Bus Insulation	No
Incoming Cable Entry	Top	Ground Bus Loc'n	Top
Incoming cable pull section	No	Vertical Ground Bus	No
Main cable termination	Screw	Ground terminations	Screw

Name	**MCC-0001**	**Location**	**Martin St.**
Access	Front only	Depth	533.4 mm
Special Instructions:			

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 The section describes the requirements for an automatic, unattended, emergency power supply system to suit the new Blind River Low Lift Pump Station.

1.1.2 The generator unit is to be based on a diesel engine prime mover that is an outdoor pad mounted type in a sound attenuated enclosure.

1.2 General

1.2.1 The emergency power supply system shall consist of a diesel electric generating unit complete with:

.1 Radiator cooled diesel electric generating unit with combined engine/generator controls

.2 Main protection and isolation breaker

.3 Load bank test breaker

.4 Kirk key mechanical interlock

.5 Accessories and equipment specified in this specification

.6 CSA/ULC certification for use as a fuel oil appliance in Ontario

1.2.2 The emergency power supply system shall consist of a factory assembled, and tested appliance.

1.3 Description of Automatic Operation

1.3.1 The generator shall automatically start upon a run command from the transfer switch.

1.3.2 When the emergency supply has reached settled voltage and frequency preset limits (adjustable) the generator shall provide a running status signal to the transfer switch.

1.3.3 The set will continue to supply the load until the transfer switch opens to disconnect the generator from the load.

1.3.4 The generator will continue to run until the run signal is removed. The transfer switch will be programmed to provide a cool-down time.

1.3.5 Generator controller will monitor an auxiliary open status contact from the combustion air intake damper actuator. In the event that the generator is running, and after a time delay the open damper status is not detected, annunciate an alarm on the generator control panel.

1.3.6 Generator controller will monitor an auxiliary low level status contact from the diesel fuel tank. In the event that a low level is detected the generator shall issue an alarm and initiate a shutdown after a time delay.

1.4 Related Sections

1.4.1 Section 01330 – Submittals

1.4.2 Section 01820 – Demonstration & Training

1.4.3 Section 16010 – Electrical General Requirements

1.4.4 Section 16225 – Motor Control Centres

1.4.5 Section 16301 – Automatic Transfer Switches

1.5 References

1.5.1 Comply with all applicable regulations and standards including:

.1 CSA C22.2 No.14 Low Voltage Control & Distribution

.2 CSA C22.2 No. 100 Motors & Generators

.3 CSA B-139 Installation code for oil-burning equipment

.4 ULC standards for fuel oil tanks and fuel oil system components.

.5 IEC 61000 Electromagnetic Compatibility

.6 ISO 8528

1.5.2 The generation system shall be CSA certified and shall comply with all TSSA requirements including ULC listings.

1.6 Coordination

1.6.1 The Contractor shall coordinate the interface between the generation system and:

.1 The automatic transfer switch, including start/stop control wiring

.2 SCADA system, including remote generator status monitoring

.3 Incoming duct banks

.4 Generator pad

.5 Diesel Fuel System, including low level status monitoring

.6 Combustion Exhaust System

1.6.2 Note that the diesel generator dimensions and configuration shown on the drawings is based on a generic standby generator.

.1 Coordinate the dimensions of the generator concrete pad with the shop drawing dimensions of the specific product that is supplied by the Contractor.

.2 Provide 100mm of exposed concrete pad around the perimeter of the generator.

1.7 Quality Assurance

1.7.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.

1.8 Submittals

1.8.1 Make submittals in accordance with Section 01330 Submittals

1.8.2 Shop drawings shall include, but not be limited to, the following:

.1 Engine: make, model, rating and performance curves.

.2 Alternator: make, model and rating complete with generator saturation curves, heat damage curves, reactive capability and special data.

.3 Voltage regulator: make, model, type.

.4 Governor: type, model.

.5 Starter motor, make model.

.6 Battery: make, type, voltage, capacity.

.7 Charger: make, model, input and output rating.

.8 Submit a general outline drawing of the complete assembly showing engine, radiator and generator mounting, exhaust, recirculating and intake air louver arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, radiator and coolant drain valves, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet. Indicate on drawings horizontal and vertical dimensions, minimum door opening required for moving the unit, head room required for removal of piston and connecting rod, and weight of engine, generator, baseplate, radiator and exhaust silencer.

.9 Base plate construction details and materials

.10 Outline and layout of all panels

.11 Schematic and wiring diagrams of engine, generator, control panel, automatic transfer isolation and bypass panels complete with interconnecting wiring diagrams.

.12 Single line diagram showing all breakers, switches, metering and protective relays.

.13 Field wiring diagrams

.14 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.

.15 Coordinated, fully dimensioned pad layout drawing showing all openings required in foundation for mechanical piping, cables, electrical feeders etc.

1.9 Operations & Maintenance Manual

1.9.1 Provide O&M manuals including all data required for operation and maintenance of the complete generation system including the following:

.1 Final versions of all information provided in the approved shop drawings.

.2 Factory test data of engine, generator, exciter, control logic, metering and all other pertinent test data

.3 Maintenance and operation bulletins for:

.1 Engine and Accessories

.2 Generator

.3 Voltage Regulator and Accessories

.4 Exciter

.5 Permanent magnet generator if installed

.6 Battery charger

.7 Speed Governor

.8 Starting Motor

.9 Batteries

.10 Ventilating Equipment

.11 Timers, Relays, Meters

.12 Power Circuit Breakers

.13 Controller, Contactors

.14 Other Accessories

.4 If brochures are submitted, these shall be originals; photocopies are not acceptable. Brochures shall contain all technically relevant data.

.5 Complete sequence of system operation.

.6 Complete bill of materials including nameplate data of equipment and accessories.

1.9.2 Provide at least 10 working days prior to the factory tests, one copy of instruction manual for each unit of different ratings to the Engineer

1.9.3 Provide within 10 working days after the factory tests, three copies of instruction manuals, with updated drawings, for each unit of different ratings, to the Engineer.

.1 Where more than one unit of identical ratings is supplied on the same purchase order, provide three copies for the first unit and two copies per unit for each succeeding unit, up to a total of six units, one copy per unit for each additional unit above this amount.

1.9.4 Crate with each unit, one copy of instruction manual, with updated drawings, plus one extra loose set of drawings all in protective cover.

1.10 Training

1.10.1 Provide training in accordance with 01820 Demonstration and Training.

2 PRODUCTS

2.1 Assembly

2.1.1 Provide the following items plus such other items as necessary to make the unit complete as implied or intended:

.1 Diesel Engine.

.2 Diesel Engine Accessories.

.3 Baseplate and Drip Pan.

.4 Vibration isolators.

.5 Governor.

.6 Engine Exhaust System.

.7 Engine Cooling System.

.8 Engine Ventilating System.

.9 Starting Motor(s).

.10 Batteries and Rack.

.11 Battery Charger.

.12 Generator and Exciter.

.13 Voltage Regulator and Accessories.

.14 Spares and Accessories.

.15 Fuel Tank.

.16 Remote Annunciator

.17 Engine & Genset Controller

.18 Weather and Sound Enclosure

2.2 Design Criteria

2.2.1 Design equipment suitable to meet the following criteria:

.1 Generator set minimum Standby Rating 150 kW, 187.5 kVA.

.2 Motor load: as shown on drawings.

.3 Largest motor: as shown on drawings.

.4 Voltage: 600V.

.5 Frequency: 60Hz

.6 Phase/Wire: as shown on drawings

.7 Power factor: 0.8

.8 Load harmonic content: 5% THD

.9 Maximum rotational speed: 1800 rpm

.10 Interrupting capacity: 35 kA

.11 Duty rating: ESP per ISO 8528

.12 Radiator Cooling Flow shall not exceed the value noted on the drawings.

.13 Allowable combustion exhaust backpressure to be no less than 10 kPa

2.2.2 Genset is to comply with CSA B139 latest eddition.

2.2.3 Genset must have a solidly grounded neutral as detailed in .

2.2.4 Unit must be designed to start and attain settled voltage and frequency limits and accept 100% rated load with voltage and frequency settling to the specified steady state bands, within 15 seconds for any temperature between 0°C to 40°C.

2.2.5 Use engine manufacturer's standard, published horsepower rating in assessing engine capacity and de-rate this rating for the specified conditions and engine driven accessories in accordance with latest revisions of ISO 3046-1.

2.2.6 Ensure that the components are suitably matched to operate with each other to provide satisfactory performance and long life, i.e.:

.1 Engine and speed governor

.2 Engine and generator

.3 Generator and voltage regulator

.4 Engine safety and control devices rigidly mounted to prevent improper functioning of related equipment.

.5 Engine instruments isolated from vibrations with anti-vibration mountings.

2.2.7 Ensure that the model and type of engine is of proven design for this class of service.

.1 Upon request, submit a list of approximately 12 recent installations in Canada, preferably in Ontario, where similar equipment has been in service over 2 years, giving engine model and type:

2.2.8 Ensure that the generator set will:

.1 Comprise components made in or stocked (over three units) in Canada and of current manufacture.

.2 Have components CSA approved where applicable and comply with the requirements of the Electrical Safety Authority

2.2.9 The Generator shall be EPA Tier 3 (US Environmental Protection Agency) Certified for Stationary Emergency Applications for emissions levels.

2.2.10 Genset Enclosure:

.1 The genset unit will be located outdoors on the new Low Lift Pump Station located on the Martin Street property.

.2 The genset shall be installed on a UL listed integrated fuel tank base equipped with a factory installed weatherproof, corrosion resistant, sound attenuating enclosure.

.3 The enclosure shall be designed and tested to comply with UL 2200 and CSA standards.

2.2.11 Sound attenuation: level to be less than 75 decibels (A-weighted) at a distance of seven metres from the unit (A-weighted).

2.2.12 The genset shall be equipped with a UL listed sub-base fuel tank sized to allow operation of the genset for 24 hours.

2.2.13 Genset shall be supplied with a spill containment around the fill pipe.

2.2.14 Genset shall be supplied with a 120/208V, 3phase auxiliary power panel mounted inside the enclosure for power to miscellaneous equipment inside the enclosure.

2.3 Mounting

2.3.1 Connect engine flywheel housing rigidly to generator stator housing with SAE adapter. Mount unit on a common, heavy duty fabricated steel baseplate. Design and materials of baseplate must be approved by engine manufacturer and the Engineer.

2.3.2 Baseplate of sufficient rigidity to maintain alignment of engine-generator shafts and frames under all conditions incident to shipping, installation and service

2.3.3 Machine the engine-generator feet and baseplate sole plates to be parallel. Shimming to be steel type and only permitted underneath the generator feet.

2.3.4 Support baseplate on spring type isolating fixtures from welded side brackets located in such a manner that bottom of baseplate will be approximately 25mm above supporting floor. Isolators shall have cast iron housings and be complete with levelling bolts, adjustable oil proof snubbers and minimum 6mm sound pads. Isolation efficiency to be not less than 95%.

2.3.5 Determine quantity and location of isolators in such a manner that each isolator will carry equal proportion of weight and that the pressure exerted on the floor by each isolator does not exceed 345kPa.

2.3.6 Isolators shall be shipped loose for installation at project site.

2.4 Diesel Engine

2.4.1 Full diesel, heavy duty, cold start, liquid cooled, in-line or 'V', and current manufacture of a type and size that has been service as a prime mover for electric power generation for not less than two years.

2.4.2 Engine shall have a minimum of four (4) cylinders.

2.4.3 Engine with auxiliary starting aids (e.g., glow plug assist start) is not acceptable.

2.4.4 Provide dry type heavy-duty air filters located close to the inlet manifold.

2.4.5 Provide engine wiring in liquid-tight conduit and fittings with insulated bushings. Use stranded, minimum No. 12 AWG, TEW 105°C and coloured coded wires. Terminate wiring with coded, insulated terminals flanged fork type or ferrules. Terminal blocks heavy duty, screw type. Wire markers of heat-shrink, oil proof type. Junction boxes on unit of liquid-tight type. Maximum of two wires per terminal block.

2.4.6 Provide engine wiring in liquid-tight conduit and fittings with insulated bushings. Use stranded, minimum No. 12 AWG, TEW 105°C and coloured coded wires. Terminate wiring with coded, insulated terminals flanged fork type or ferrules. Terminal blocks shall be heavy duty, screw type. Wire markers shall be heat-shrink, oil proof type. Junction boxes on unit shall be of liquid-tight type. Maximum of two wires per terminal block.

2.4.7 Mount unit accessories, including gauges, instruments, and protective sensors, in such a manner that machine vibrations are isolated or damped.

2.4.8 Dynamically balance complete engine-flywheel generator arrangement after assembly. Guarantee no torsional or other harmful vibrations within 10% above or below rated speed of unit, when operating unloaded or connected to any load within its rating. Cyclic irregularity to be no greater than 1/250.

2.4.9 Unit must not experience vibration or displacement greater than 6 mils or a velocity greater than 1.0 cm/sec measured over a spectrum of 100 HZ to 10,000 HZ. Measurements shall be taken at NL, 25%, 50%, 75%, and 100% full load.

2.4.10 Provide engine flywheel with graduated marking around its periphery to facilitate fuel injection and valve timing.

2.4.11 Provide removable wet type cylinder liners. Furnish cylinder head with removable valve seat insert and guides.

2.4.12 Provide personnel safety guards for exposed moving parts and exhaust manifolds. Provide platform for servicing upper part of engine where applicable.

2.5 Jacket Water Cooling System

2.5.1 This assembly covers a locally mounted radiator situated on the engine base with an engine driven fan and a totally enclosed water system.

2.5.2 Pusher fan to be driven from the engine with V-belt(s).

2.5.3 Radiator, mounted on set base, amply sized to cool the engine under full load and overload conditions at the listed site ambient conditions.

2.5.4 Provide radiator inlet cowling, outlet ducting flange, and flexible canvas boot for mounting on the front of the radiator, flanged on both sides, length 100 mm minimum.

2.5.5 Engine driven water circulating pump.

2.5.6 Temperature regulating valve with bypass feature, located in cylinder head water outlet.

2.5.7 Water pipes, flexible hoses, etc., drain cocks to permit the complete system to be drained.

2.5.8 Safety protection guards around all moving parts.

2.5.9 The Contractor shall supply all necessary Ethylene Glycol/Water at a 50/50 concentration by volume until equipment is commissioned.

2.5.10 Engine Jacket Water Coolant

.1 Long life ethylene glycol c/w additives.

2.6 Lubrication System

2.6.1 Provide a full pressure lubricating system complete with duplex filters and oil cooler.

2.6.2 Oil pump shall be engine driven gear type complete with strainer.

2.6.3 Equip filters with automatic by-pass valve and full flow filter elements conveniently located for servicing and directly replaceable. Cooler to have sufficient capacity to maintain oil temperature within 93°C with unit operating at rated load under conditions specified.

2.6.4 Equip engine oil sump with oil drain pipe, gate valve and pipe cap. Permit complete drainage in a convenient manner. Extend 75mm beyond base plate.

2.6.5 All metallic oil hoses shall be of the steel reinforced rubber type with crimped or swaged end fittings.

2.7 Fuel System

2.7.1 Provide a complete fuel system including fuel lift pump and duplex filters. Filter elements to be directly replaceable.

2.7.2 Hoses and connections to the fuel system shall be certified in accordance with CSA B139 latest addition.

2.7.3 Fuel pump to have suction lift capability to suit the installation.

2.7.4 Flexible connectors, bronze corrugated type for the suction and return lines, located in a horizontal plane and secured at one end to the engine base. Equal to “United Flexible” type BA.

2.7.5 All non-metallic fuel hoses shall be of the steel reinforced rubber type with crimped or swaged end fittings.

2.7.6 Fuel system to include a fuel filter/water separator ie: Racor or equal.

2.7.7 All fuel piping to be schedule 40, carbon steel with welded and/or threaded construction.

2.7.8 For outdoor units, provide a ULC listed sub-base fuel tank for at least 24 hours operation

2.8 Exhaust System

2.8.1 Provide a complete exhaust system including combustion exhaust silencer with condensate drain, plug and flanged couplings; stainless steel, corrugated expansion joints, of suitable length, to absorb both vertical and horizontal expansion; all flanges, bolts, gaskets, adjustable hangers and pipe and thimble to permit projection of pipe 200 mm beyond wall.

2.8.2 All interior exhaust piping and silencer shall be insulated

2.8.3 Arrange exhaust system to suit openings. Where schedule of dimensions does not indicate location of opening, arrange exhaust run best suited to the engine.

2.8.4 The Exhaust system shall include exhaust silencers, to meet the sound attenuation requirements of the generator system.

2.8.5 Exhaust silencer outlet flange: ANSI Flange, 125/150#

2.8.6 Flexible connection at engine

.1 Exhaust flexible connection, T321 stainless steel, bellows type 600mm length, ANSI flanges for connecting to the exhaust manifold.

.2 Approved Suppliers:

.1 Flexonics

.2 Silex

.3 Approved equal

2.8.7 Exhaust silencers

.1 One (1) silencer shall be provided to attenuate both high and low frequency noise.

.2 Silencers to be rated for 510°C temperature.

.3 Silencers to be provided with flanges and port orientation as shown on drawings

.4 Silencer

.1 Providing minimum attenuation of 35-50 dBA across the audible range of the frequency spectrum 63 to 600Hz

.2 Silencer to be constructed of stainless steel.

.3 The silencer is to be insulated with a custom fabricated Firwin 1200 insulating blanket. Insulating blanket to be 25 mm thick

.4 Provide a 12mm drain piped to a discharge point using copper tubing. Tubing to be terminated with a ball valve as directed by the Engineer.

.5 Finish: 510°C high temperature aluminium paint.

.6 Acceptable Suppliers:

.1 SMS Exhaust

.2 Silex

.3 Approved Equivalent

2.8.8 The combustion exhaust system is to be CSA/ULC certified to suit the generation system package.

2.8.9 Provide insulation in accordance with section 15400

2.8.10 Exhaust Manifold

.1 The engine exhaust manifold to be insulated with a custom fabricated Firwin 1200 insulating blanket. Insulating blanket to be 25 mm thick

2.9 Jacket Coolant Heater

2.9.1 Provide engine jacket coolant heater[s] complete with 20°C to 60°C adjustable immersion type thermostat. Size heaters to maintain coolant at 40°C in an ambient temperature of -10°C or the minimum design enclosure temperature, whichever is lower.

2.9.2 Obtain circulation of heated coolant on Thermosiphon principle. However, if this does not provide sufficient circulation to avoid hot spots in the system, provide electrical motor driven circulating pump to operate automatically when heater is energized. Motor to be 120 V single phase splash-proof type complete with breaker type combination starter. Starter in wall-mounting enclosure mounted in control panel.

2.9.3 Heater and Aquastat to be Kim Hotstart or equivalent.

2.10 Speed Governor

2.10.1 Provide full electronic governor with speed changer and dry type actuator. Governing system shall be in accordance with ISO 3046-4.

2.10.2 Governor shall provide the following features:

.1 Ten turn locking type manual speed adjustment.

.2 Speed regulation, steady state, no-load to full load and vice versa: +/-0.25%.

.3 Transient peak, no-load to full-load and vice versa +/-10%.

.4 Recovery time to steady state condition on application of full load from no load not to exceed 3 seconds.

.5 Frequency shall be externally adjustable from zero to 5% while engine is running.

.6 Class A accuracy.

2.11 Starting System

2.11.1 Provide a complete 24VDC starting system including cranking starting motor(s), batteries, battery stand, heavy-duty battery cables and battery charger.

2.11.2 Provide positive engaging type cranking motor(s). Cranking motor and flywheel ring gear arrangements which may permit tooth to tooth abutment not acceptable.

2.11.3 Provide lead acid battery, type 8D with sufficient capacity in an ambient room temperature of 0°C to crank the unit at engine manufacturer's recommended cranking starting speed for a period of 3 minutes. Voltage measured at starting motor terminals at end of 3 minutes cranking, with cranking current flowing, to be not less than 1.75V per cell. Size battery on the basis of engine and battery manufacturer's published data. Batteries to be dry charged, specific gravity of electrolyte 1.22 when fully charged at 27ºC. Battery termination shall be bolt-on or study type. Terminals and all exposed electrical connections shall be protected from accidental short circuit by falling conductive objects on the battery. Such protection shall be transparent.

2.11.4 Provide battery stand coated with acid resistant paint and fabricated from angle irons with 20 mm plywood bottom and heavy duty casters for ease of movement.

2.11.5 Provide battery charger with 120 volt AC input and output equal to 1.20 of the ampere-hour capacity of the battery based on an 8 h rate. Output voltage ripple shall be 3% or less. Provide an AC input circuit breaker and a 24 h terminating equalizer timer with approximately 4 m of connecting cord and permanent connectors for connecting to battery terminals. Provide 5 spare fuses inside charger panel. Charger to be CSA approved.

2.11.6 Provide necessary heavy duty, maintenance-free battery cables and connectors. Select cable wire size on the basis of allowing not more than 5% voltage drop at time of peak load. Cable length to be sufficient to allow battery to be located on either side of the engine.

2.12 Generator Alternator

2.12.1 Provide generator, drip proof, single bearing and close coupled to engine with SAE housing. Generator to have a full amortisseur winding, direct connected brushless exciter with easily removable bolt-on diodes with surge protection and meet or exceed NEMA MG1-22 and current IEEE Standards.

2.12.2 Maximum deviation of open circuit terminal voltage waveform not to exceed 5%.

2.12.3 Provide permanent magnet generator (PMG) for generator short circuit sustaining capability not less than 2.4 of rated current.

2.12.4 Generator winding insulation shall be Class F; winding temperature rise not to exceed 105°C as measured by resistance in an ambient temperature of 40°C.

2.12.5 Identify generator windings with metal tags. Bring windings to insulated terminals in a metal junction box mounted on the side or top of generator. Size junction box to permit mounting of engine and generator low voltage controls and wiring terminals blocks. Provide barrier in junction box to separate low and high voltage wiring.

2.12.6 Design equipment to minimize radio frequency interference (RFI) under all operating conditions. Balanced telephone influence factor (TIF) to meet or better requirements of EEMAC Standard MG1-22.43. for 600V, 3 phase, 60 HZ, 1800 RPM.

2.12.7 Acceptable alternator manufacturers:

.1 Century

.2 Onan

.3 Stamford

.4 Marathon

.5 Or approved equivalent

2.13 Voltage Regulator

2.13.1 Provide a voltage regulation system complete with auto/manual control module. Voltage regulator shall be capable of withstanding continuous vibration, 15 shock and temperature up to 50°C while maintaining accuracy to plus/minus 1%.

2.13.2 Steady-state voltage regulation not to exceed 1%. Transient voltage regulation, when full load is applied or removed, not to exceed 10% when measured by oscilloscope or high speed strip chart recorder with recovery time to steady-state less than 3 seconds.

2.13.3 The automatic voltage regulator shall be a Basler SSR63-12 AVR or equal.

2.13.4 AVR to have following features:

.1 Regulation: ±0.25%, steady state, NL to FL.

.2 Sensing: three (3) phase, 600 V AC, 60 Hz.

.3 External voltage adjust range: ±10% of nominal voltage.

.4 Built in EMI interface suppression and built in under frequency control for 60 Hz operation.

.1 Under frequency roll off which shall reduce output voltage in proportion to frequency below a threshold of 54 Hz.

.5 Operating Temperature: -40°C to 60°C.

.6 AVR to be located in control cubicle.

.1 NOTE: If additional field resistance is required, locate resistor in switchgear/control cubicle.

.7 Recovery time from load change to steady state regulation better than two (2) seconds.

.1 NL to 25% load

.2 NL to 50% load

.3 NL to 75% load

.4 NL to 100% load

2.14 Panel – General

2.14.1 The genset panel shall be mounted on the genset, dead front type, fabricated from steel and supplied complete with lifting eye bolts. Doors shall have formed edges, be reinforced by stiffeners and complete with lockable handles.

2.14.2 Design and construct panel to withstand strains, jars, vibrations and other conditions incident to shipping, storage, installation and service.

2.14.3 Build the control panel with the following features:

.1 CSA enclosure 2, with upper side ventilation, engine mounted, constructed of #14 gauge steel, rigidly braced, vibration isolated, suitable for mounting on the generator alternator, sized to suit the control system requirements.

.2 Mounted sub-bracket for generator circuit breaker and load bank test circuit breaker, arranged to permit the handle to project through a slot in the door (but not located on the door). Generator breaker to be mounted on the generator alternator housing, including vibration isolation as required to suit the application.

2.14.4 Panel to be CSA certified. Mount a nameplate bearing CSA monogram in a prominent position on panel.

2.14.5 Identify all instruments and controls with lamacoid or metal engraved nameplates fastened by rivets or screws for permanent identification. All items mounted on door shall also be identified with nameplates. Nameplates shall not be attached to removable items such as relays and wireway covers.

2.14.6 Provide panel with bolted rear covers or removable side panels.

2.14.7 Factory wire panel completely. Use stranded, minimum No. 14 AWG, TEW 105°C and coloured for control wiring. Use No. 10 AWG for CT secondary connections:

.1 Blue - DC control.

.2 Red - AC control.

.3 Black - PT secondary connections.

.4 Orange - CT secondary connections.

.5 Green - non-current carrying ground.

.6 White - current carrying ground.

.7 Yellow - interlocks.

.8 Brown - generator excitation system.

2.14.8 Code wiring at each wire end with permanent, non-aging slip on markers. Support and run wiring neatly. Protect wiring from mechanical damage by grommets and shields.

2.14.9 Terminal blocks to be coded, clamp type, serrated for positive grip and of tough, non-brittle, unbreakable nylon, MTE size 3,453/0 or equivalent. For current transformer secondary circuits, provide terminals blocks of dual connector type, Electrovert 9060 or equal. Provide test block for current transformer secondary connections.

2.14.10 Provide door detent mechanism to maintain hinged door at the open position.

2.14.11 Supply 2 sets of wiring markers for each external wiring connection. Markers shall be contained in a plastic bag and secured inside the panel.

2.14.12 Use wiring duct for interconnection within panel.

2.14.13 Direct inter-panel connection not permitted, use terminal blocks.

2.14.14 Provide a kirk key mechanical interlock between the load bank test breaker and the generator main breaker. The interlock shall be configured such that the key is trapped in the closed position of one breaker and must be released before the other breaker can be closed, thereby preventing simultaneous closure of both breakers.

2.15 Control Panel

2.15.1 Provide a control panel for controlling engine generator unit.

2.15.2 Provide hinged front door.

2.15.3 Electrical connection of components to be as shown in solid lines on the drawing.

2.15.4 Mount terminal blocks on common mounting strips for interconnection wiring between the following:

.1 Sub-panel and panel door.

.2 Sub-panel and external wiring from diesel generator unit circuits.

.3 Sub-panel and external indicating circuits.

.4 Sub-panel and secondary circuits of power sub-cubicle.

.5 Sub-panel and external wiring from power transfer panel.

2.15.5 Provide a 1 cm x 4 cm horizontal copper ground bus for the whole length of the enclosure, and two ground lugs; one at each end. The lug shall be capable of accepting grounding conductor of range from No. 8 to No. 2/0 AWG.

2.15.6 Terminal blocks to be CSA approved, clamp type, serrated for positive grip and of tough, non-brittle unbreakable nylon material. Maximum two wires per terminal block. Use factory made terminal block jumpers wherever necessary.

2.15.7 Provide circuit breakers for equipment protection: fuses shall only be used where breakers are not applicable.

2.15.8 Provide top and bottom entry for power and control cables. Bottom plate shall be removable and sized 0.45 m by 0.15 m.

2.16 Engine/Generator Controller

2.16.1 The engine/generator controller shall be microprocessor based and shall contain the following basic features; automatic and manual start/stop control modes, monitoring and control of essential engine generator set parameters and automatic shutdown and/or alarm status of specified protection fault circuits. The automatic operation mode shall have provisions for accepting an automatic starting/stopping signal from a remote device. Alarm and shutdown fault circuits provided shall meet CSA 282, building code standards and NFPA 110 level 1 regulatory standards. The following alarm and shutdown fault circuits shall be provided (but not be limited to):

.1 Low Oil Pressure Shutdown

.2 High engine Temperature Shutdown

.3 Low Coolant level Shutdown

.4 Low Fuel Level Alarm & Shutdown

.5 Over crank Shutdown

.6 Over speed Shutdown

.7 Loss of speed Shutdown

.8 Low battery voltage Alarm

.9 High battery voltage Alarm

.10 Weak battery Alarm

.11 Low oil pressure Alarm

.12 High engine temperature Alarm and Shutdown

.13 Low engine temperature Alarm

.14 Reverse power Shutdown

.15 Under voltage Shutdown

.16 Overvoltage Shutdown

.17 Under frequency Shutdown

.18 Over frequency Shutdown

.19 Breaker Tripped Shutdown

.20 Fail to Sync Alarm

.21 Emergency Stop Shutdown

.22 Switch not in auto Alarm

.23 Spare Shutdown

.24 Spare Shutdown

2.16.2 The microprocessor based engine/generator controller shall include a security password system for access to all programming functions. Specific password levels shall be provided for “read only”, “read/write” and “master”. All programming set points for voltage, frequency and time delays shall be software programmable from the front panel mounted keypad, and all parameters shall be displayed in alpha numeric format.

2.16.3 The microprocessor based engine/generator controller shall include an operator interface, liquid crystal display (LCD) screen which is door mounted. The following parameters shall be displayable:

.1 Generator AC digital metering (3 phase V, A, F)

.2 Timer countdown display

.3 Operating status /switch position

.4 Alarm/Shutdown fault display

.5 Engine Hour meter

.6 Engine Oil Pressure (kPa)

.7 Engine Coolant Temperature (°C)

.8 Engine RPM (Tachometer)

.9 Battery Voltage

2.16.4 Generator AC digital metering shall be integral to the engine generator controller and the Multifunction Generator Protection relay (they shall have an accuracy of +/-1%). The digital metering shall be fully programmable from the front panel display. Programming for voltage and current PT/CT ratios and software calibration shall be provided for all input ranges. The following generator output AC parameters shall be monitored and displayed:

.1 AC Voltage -3 phase (line to line and average)

.2 AC Current -3 phase (individual phases and average)

.3 AC frequency (resolution to 0.1 Hz)

2.16.5 Digital display of Engine parameters shall be provided by the engine/generator controller. Engine oil pressure and engine temperature shall be monitored and shall be displayed in metric or imperial engineering units. Oil pressure and temperature senders shall be supplied for mounting on the engine generator set.

2.16.6 Long life LED type pilot lights shall be provided on the engine/generator controller to indicate general operating conditions as follows:

.1 Common Alarm (Flashing-Amber)

.2 Common Shutdown (Flashing-Red)

.3 System Ready (Green)

.4 Speed Signal Present (Green)

2.16.7 The engine/generator controller shall include the following protective functions:

.1 Three phase under/over voltage protection. The under/over voltage protection function shall be programmable as follows:

.1 under voltage pick-up 70-100% of nominal, factory set at 90%.

.2 under voltage dropout 70-100% of nominal, factory set at 80%.

.3 under voltage delay 0 - 10 seconds, factory set at 3 seconds.

.4 over voltage pick-up 100-130% of nominal, factory set at 110%.

.5 over voltage dropout 100-130% of nominal, factory set at 108%.

.6 over voltage delay 0 - 10 seconds, factory set at 2 seconds.

.2 Over/under frequency protection. The over/under frequency protection function shall be programmable as follows:

.1 under frequency setpoint 70-100% of nominal, factory set at 90%.

.2 under frequency delay 0 - 10 seconds, factory set at 5 seconds.

.3 over frequency setpoint 100-130% of nominal, factory set at 110%.

.4 over frequency delay 0 - 10 seconds, factory set at 2 seconds.

.3 Three phase over current alarm protection shall be provided for the engine generator. The over current protection function shall be programmable as follows:

.1 over current setpoint 100-150% of nominal, factory set at 110%.

.2 over current delay 0 - 10 seconds, factory set at 5 seconds.

.4 Low/High battery voltage protection. The protection function shall be programmable as follows:

.1 Low battery voltage set point 50-100% of nominal, factory set at 12.8Vdc (12VDC systems) or 25.6Vdc (24VDC systems).

.2 Low battery voltage delay 0-300 seconds, factory set at 120 seconds.

.3 High battery voltage set point 100-130% of nominal, factory set at 15.2Vdc (12VDC systems); 30.4Vdc (24VDC systems).

.4 High battery voltage delay 0-300 seconds, factory set at 10 seconds.

.5 Weak battery sensing shall be provided to detect a low capacity engine starting battery system. This function shall be programmable as follows:

.1 Weak battery set point 50-100% of nominal, factory set at 8.0VDC (12VDC systems) 18.0Vdc (24VDC systems).

.2 Weak battery transient delay 0-300 seconds, factory set at 3 seconds.

2.16.8 Diagnostic LED's shall be provided on the rear of engine/generator controller module to allow simple visual indication of operating status or mode. Individual LED's shall be provided for the following functions:

.1 Watchdog (CPU running)

.2 Remote start signal activated

.3 Crank output energized

.4 Run output energized

.5 Common fail alarm activated

2.16.9 The engine/generator controller shall have an audible alarm feature to signal shutdown and alarm conditions.

2.16.10 The engine/generator controller shall include the following operator control functions:

.1 Operation Mode (Auto/Off/Manual/Load Test)

.2 Programming (Enter/Exit/Value Increment/Decrement)

.3 Lamp Test

.4 Fault Reset

.5 Alarm Horn Silence

.6 Emergency Stop

2.16.11 The engine/generator controller shall provide cycle cranking control logic with programmable number of crank attempts (Adj. 1-99, factory set at 3 attempts) crank period time (Adj 0-99 sec, factory set at 15 sec) and rest period time (Adj 0 99 sec, factory set at 10 sec).

2.16.12 Engine control logic shall include the following sensing and protection circuits:

.1 Loss of speed signal sensing shutdown

.2 Starter re-engage sensing control (to re-engage starter motor upon initial failure to engage).

.3 Run output fail safe selection (to prevent engine starting if speed signal is not present).

2.16.13 Programmable output function contacts shall be provided by the engine generator controller. Contacts shall be type Form C, rated 10A, 240Vac, 30Vdc resistive, maximum. The following programmable output control functions shall be available for specific system applications:

.1 Engine run x 3

.2 System ready

.3 Common alarm

.4 Switch not in auto

.5 Common shutdown

2.16.14 A time delay on engine start shall be provided to delay the engine start signal. The time delay shall be programmable 0 - 60 seconds, factory set at 2 seconds

2.16.15 A time delay for engine cool down shall be provided which delays engine stopping. The time delay shall be programmable 0 - 30 minutes, factory set at 5 minutes.

2.16.16 The engine generator controller shall provide a lamp test function to test all LED lights and the LCD display.

2.16.17 The engine/generator controller shall have the ability for remote communication of all status points (alarms, shutdowns, switch position) and all measured analog values. Remote control and configuration of all switch functions and setups shall be supported. Communication shall be via RS422/485 port located on the engine generator controllers. The RS422/485 shall allow all engine controllers to be interconnected together to form a common communication

link. A common communication module shall be provided which shall provide communication to all connected engine controllers. The communication module shall support ModbusR or Allen Bradley DH485 or AB Device Net or Ethernet software protocol for interconnection into Region's SCADA system.

2.16.18 AC METERING

.1 Analog metering shall be provided to monitor the output of the engine generator. Metering shall be 100 mm, 250 degree movement with 1% accuracy and scaled to suit the specific application. The following meter types shall be provided:

.1 AC Voltmeter c/w phase selector switch (line to line)

.2 AC Ammeter c/w phase selector switch

.3 Frequency Meter

.4 Kilowatt Meter

.5 Power factor Meter

.2 Potential and current metering transformers shall be provided of adequate burden and thermal ratings to meet the specified metering accuracy. Potential transformers shall be provided with primary side fusing of adequate rating.

2.17 Remote Status Indicator Panel

2.17.1 Provide a remote status display panel with indicator lights for:

.1 Generator Running

.2 Low oil pressure

.3 High engine Temperature

.4 Low Coolant level

.5 Low Fuel Level

.6 Overcrank

.7 Overspeed

.8 Loss of speed

.9 Low battery voltage

.10 High battery voltage

.11 Weak battery

.12 Low oil pressure

.13 High engine temperature

.14 Low engine temperature

.15 Reverse power

.16 Undervoltage

.17 Overvoltage

.18 Underfrequency

.19 Overfrequency

.20 Breaker Tripped

.21 Fail to Sync

.22 Emergency Stop

.23 Switch not in auto

2.17.2 Surface mounted NEMA 1 enclosure. Located as shown on the drawings and finalized on site.

2.17.3 CSA certified.

2.17.4 Designed for operation in -40 degrees Celsius to +70 degrees Celsius

2.17.5 Network connection type to suit, complete with network cable length to suit the application.

2.17.6 Rated for operation at 120VAC.

2.18 Engine Wiring and Terminal Box

2.18.1 Provide heat and oil resistant wire from the safety switches and control devices. Run the wire neatly in a harness, secure to the engine and terminate at the engine terminal box.

2.18.2 Provide a CSA enclosure 5 for the engine terminal box with a numbered terminal strip to correspond with the schematic diagram. Provide a separate junction box for the 120V & 24VDC circuits.

2.19 Engine Gauges

2.19.1 Provide the following engine gauges.

.1 Lube oil pressure gauge.

.2 Lube oil temperature gauge.

.3 Jacket water temperature gauge.

.4 Pyrometer (Dual scale for V type Engines)

2.20 Finishing and Painting

2.20.1 Properly clean, finish and paint equipment with a smooth and durable finish.

2.20.2 Generator and enclosure exterior shall be factory standard colour, gloss paint.

2.20.3 Interior of enclosure and interior of all control panels shall be white gloss.

2.20.4 Provide 250 ml of touch-up paint.

2.20.5 Provide two (2) aerosol bottles paint, matching the finish colour and suitable for spraying over the finish to cover graffiti.

2.20.6 Paint the complete equipment, except finished and machined parts also special items listed below:

.1 One coat of primer, red lead, iron oxide, oil alkyd, heat resistant 0.04 - 0.05 mm dry.

.2 One top coat of enamel, alkyd gloss, heat resistant, 0.05 - 0.08 mm minimum.

.3 Protect data labels on all equipment while painting and ensure labels are legible.

.4 Coat liberally, all finished and machined parts with petroleum or wax base, temporary protective coating.

.5 Paint protective guards on the set red.

.6 Finish the control panel white on the inside and light gray on the outside unless otherwise noted.

.7 Finish the exhaust silencer and flexible connector with aluminum silicone alkyd paint, heat resistant to approximately 650°C.

2.21 Fluids

2.21.1 Provide all fuel required for commissioning.

2.21.2 Provide all engine oil, and coolant required for commissioning.

2.21.3 Replace engine oil upon completion of commissioning and dispose of used oil.

2.21.4 Fill fuel tank upon completion of commissioning.

2.21.5 Provide sufficient oil and coolant for first fluid replacement by owner.

2.22 Tools

2.22.1 Supply suitable engine barring device and the battery manufacturer's standard set of tools for battery service. Battery service tools to include as a minimum, hydrometer, one plastic bottle for topping up purposes and one insulated battery terminal wrench.

2.22.2 Provide a complete set of specialized tools required for the proper care, adjustment and maintenance of equipment supplied.

2.23 Signs

2.23.1 Provide at the front top of each panel and on each generator junction box, a lamacoid or metal engraved identification nameplate.

2.24 Spares

.1 For panels provide the following:

.1 One spare control circuit breaker per rating.

.2 One spare indicating light assembly of each rating/colour.

.3 One spare control relay and socket per rating and contact arrangement.

.4 One spare contactor operating coil.

.2 For the generator unit, provide a set of spare parts and consumables for one year normal operation and 1,000 operating hours. Include as a minimum:

.1 Six fuel filter elements for each type of fuel filter/water separator.

.2 Six lubricating oil filter elements.

.3 Three air cleaner elements.

.4 One injector assembly.

.5 One set of drive belts.

.6 Spare parts shall be products of the generator manufacturer.

2.24.2 Provide the name and contact information for a well-established Canadian distributor. Provide proof that the distributor has current Canadian stock of all spare parts likely to be required during the normal life of the engine.

2.25 Workmanship

2.25.1 Manufacture and construct the equipment with new materials, and in the best workmanship manner.

2.25.2 Give particular attention to freedom from blemishes, defects, burrs and sharp edges; accuracy of dimensions and marking of parts and assemblies; thoroughness of welding, brazing, painting and wiring, alignment of parts and tightness of assembly screws and bolts.

2.26 Weathertight “Skin-Tight” Sound Attentuated Enclosure for the Generator Set

2.26.1 This section identifies the requirement for supply and installation of a Skin-Tight Watertight Sound Attenuated Enclosure for a standby diesel engine/generator.

2.26.2 Provide attenuation levels prescribed for noise limits identified in O. Reg. 346/12 (Registrations under Part II.2 of the Act – Heating Systems and Standby Power Systems)

2.26.3 Sound pressure level to be less than 75 decibels (A-weighted) at a distance of seven metres from the unit (A-weighted) at a distance of seven metres from the unit.

2.26.4 Description of System: The weather-tight Sound Attenuated Enclosure shall consist of the following but not limited to:

.1 Side-mounted Generator Controls

.2 Lockable Access Doors

.3 Air Intake Assembly

.4 Flexible and Protected connections of Exhaust pipes

.5 Motorized Louvers

.6 Pre-wired AC Distribution Panel

.7 Rough-in for Fire Alarm system

.8 UL/ULC listed sub-base Fuel Tank and accessories

2.26.5 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01300 - Submittals.

.2 Include but not limited to:

.1 Layout of standby generator inside the skin-tight enclosure

.2 Bi-Fuel System (if applicable)

.3 Layout of all accessories

.4 Layout of Air Intake and Discharge Assemblies

.5 Sub-base Fuel Tank

.6 Exhaust System with damper thermostatically controlled

.7 Electrical Panels and Details

.8 Control Panel

.9 Cooling System

.10 Access Doors

.11 Foundation for the skin-tight enclosure

.12 Motorize Dampers and actuators

.13 Flexible connectors

.14 Heating and Cooling Systems

.15 Vertical discharge plenum c/w air baffles, air guides, and removal grills, bird screens

.16 Electrical Systems – receptacles, power details etc.

.17 Mechanical Systems

.18 Miscellaneous Items

2.26.6 Exterior Sheet Panels (Walls and Roof): All exterior sheet panels (walls and roof) shell be 12 gauge steel – painted to desired colour and colour code (selected by client designee)

2.26.7 Interior Sheet Panels: Interior wall and roof assembly lined with 22 gauge perforated, galvanized steel, complete with galvanized corner trims along interior perimeter of roof.

2.26.8 Assembly

.1 Wall, roof and door construction designed to meet the acoustic objective complete with high-density fiberglass insulation in panels. All insulation shall be covered in polyester film.

.2 Roof construction complete with 14 gauge formed channels for structure at maximum 305mm centers. Roof thickness designed and fabricated to achieve acoustic objective. Upcapped seams for water tightness and single pitch roof slope of 25.4mm for water run-off.

.3 Side and End Wall assemblies fabricated with internal galvanized 12 gauge galvanized steel formed channels, on maximum 610mm centers. Wall construction designed to achieve acoustic objective.

.4 Heavy-duty 50.8mm deflection spring isolators between genset and base.

.5 Vertical discharge assembly.

.6 Installation of all equipment inside enclosure, i.e: genset, exhaust silencer, plumbing works.

2.26.9 Access Doors:

.1 Insulated, weatherproof access doors complete with the following:

.1 Insulated, weatherproof double access doors for “skin” enclosures for removal of big equipment – lockable with drip rain shields above doors.

.2 Exterior lockable zinc plated door handle, padlock-style.

.3 Each door equipped with stainless steel hinges.

.4 Door framing complete with acoustic / weather tight seals.

.5 Door chains against wind pressure.

.6 Drip rain shields above each door.

.7 Acoustic insulation.

2.26.10 Air Intake Assembly:

.1 Side intake flow configuration.

.2 Intake hood with bird screen.

.3 Internally mounted motorized aluminum dampers, sized to suit, c/w damper actuators – on/off model, sized to suit.

.4 Internally mounted air intake high performance duct silencer, sized to suit.

2.26.11 Air Discharge Assembly:

.1 Flexible connector at radiator discharge for genset vibration.

.2 Vertical discharge flow configuration.

.3 Vertical discharge, double walled, flow configuration c/w air baffles, air guides and removable grill.

.4 Internally mounted motorized aluminum dampers, sized to suit, c/w damper actuators – on/off model, sized to suit.

.5 Exhaust fan for heat removal c/w insulated damper, on/off actuator, and fixed louver with bird screen.

2.26.12 Fuel Assembly:

.1 Double wall sub base Fuel Tank 1000 liters designed and certified to latest ULC 142.18 standards for Safety. Plumbing: vent to exterior of enclosure and provide insect mesh, fuel fills pipes (exterior) and return from genset to fuel tank.

.2 Accessories to include: leak detector, mechanical fuel gauge, and two low level switches for two levels.

.3 Mechanical Fuel Gauge

2.26.13 Electrical Equipment: Supply, install, wire and include the following but not limited to:

.1 250A, 600V, 3Ø, main breaker.

.2 Wiring and supply as required - genset coolant heater, battery charger, damper motors c/w thermostats, exhaust fans, motorized dampers.

.3 Rough-in for fire alarm system - heat detector, manual pull stations, horns (installation of devices and connection to fire alarm panel by electrical contractor).

2.26.14 Exhaust System: Exhaust silencer hospital grade installed inside of enclosure c/w flexible connector. Piped from genset exhaust manifold to exhaust silencer intake flange. Insulation

wrap (thermal) for exhaust silencer to protect service personnel. Supply and install rain cap and rain shield.

2.26.15 Plumbing System: Supply, install, and include the following but not limited to:

.1 All plumbing work between genset, fuel tank, fuel fill pipe, vent pipe etc.

.2 All plumbing work for fuel tank accessories – low level switches, leak detector, mechanical fuel gauge etc.

.3 Miscellaneous plumbing works

2.26.16 Coordination:

.1 The Contractor shall submit complete shop equipment drawings, slab openings and other coordinated drawings immediately on award of the contract.

.2 Coordinated shop drawings in (mm) shall clearly indicate all openings required in foundation for mechanical piping, cables, electrical feeders etc.

.3 Coordinate work with Client's designee and equipment suppliers.

.4 Final approved construction drawings shall contain supplier(s) engineer's stamp

2.27 Acceptable Genset Manufacturers

.1 Caterpillar – Toromont Power

.2 Cummins Eastern Canada

.3 Approved Equivalent

3 EXECUTION

3.1 Shipping, Handling and Storage

3.1.1 Comply with the requirements of Section 01610 – General Equipment Stipulations.

3.1.2 Protect the equipment against corrosion, dampness, heavy rain, etc. Also, provide adequate protection against damage or loss of components from the time the equipment leaves the manufacturer's factory until received at the destination. Ensure packing is acceptable to the transportation companies.

3.1.3 Include heavy duty plastic sheet or bags to cover components vulnerable to construction dust. Tag this packing suitable to instruct the Contractor to leave this protection in place (where practical) until construction and clean up is complete.

3.1.4 Arrange the engine for shipment and suitably tagged with warning labels.

.1 Tag the engine sump that the lube oil to be replaced at commissioning.

.2 Tag the radiator, etc., to show that the coolant includes antifreeze.

3.1.5 Provide in each manual, a complete inventory of all spare parts, tools and accessories, a copy to accompany the shipment and a copy forwarded to the Engineer and/or Site Engineer.

3.1.6 Do not ship the equipment from the plant except by prior agreement with the Engineer and the purchaser.

3.1.7 Arrange the shipment on the transport to facilitate off-loading by the Contractor's crane or skids at the job site.

3.2 Warranty

3.2.1 Provide a written guarantee (for complete parts & labour and all incidental charges including overhead & profit) signed and issued in the name of the Owner stating that the complete assembly consisting of the generator unit and all equipment and accessories is guaranteed against defects and malfunction for a period of one (1) year from the date of Substantial Performance.

3.3 Extended Warranty

3.3.1 Provide extended written guarantee signed and issued in the name of the Owner stating that the written guarantee item 3.2.1 is extended up to five (5) years from the date of factory delivery.

3.4 Factory Testing

3.4.1 General:

.1 Before acceptance, assemble and set up the unit, complete with specified equipment, for tests at the supplier's plant. Tests shall be witnessed by the Engineer on a date mutually agreed on date and time. Provide suitable test area with adjustable loading facilities. Supplier shall ensure that the engine has run in sufficiently prior to load test, all test forms filled in, system debugged and recorders connected.

3.4.2 Examination of product:

.1 A complete mechanical and electrical examination to determine compliance with specification and drawings with respect to materials, workmanship, dimensions and marking.

3.4.3 Non-operational tests and checks:

.1 Perform following test and checks before starting the unit:

.1 Shaft alignment, end float, angular and parallel.

.2 Cold resistance of generator windings.

.3 Belt tensioning.

.4 Equipment grounds.

.5 Electrical wiring.

.6 All grease lubricating points.

.7 Personnel safety guards.

.8 Air cleaner.

.9 Coolant.

.10 Lubricating oil type and level.

.11 Type of fuel.

.12 Vibration isolator adjustment.

.13 Temperature and pressure sensors.

.14 Engine exhaust system.

.15 Tools.

.16 Spares.

3.4.4 Operation test and check:

.1 On completion of paragraph 3.4.3, start the unit cold. Provide multi-channel recorder and loadbank for the test. Record the following:

.1 Time for unit to start and reach settled voltage and frequency.

.2 Time from initiation of start to full load application, with voltage and frequency settled.

.3 Voltage and frequency transient and steady state limits for full load to no load, 4/4 load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa. Measure machine vibration levels under the same load conditions. Note: Generator transient performance shall comply with International Standard ISO 8528-5 performance class G2 as a minimum. The maximum voltage dip is expected to be <20% and voltage recovery time <6 seconds.

.4 Record battery voltage drop during cranking.

3.4.5 Protection and control demonstration:

.1 On completion of paragraph 3.4.4, demonstrate the following:

.1 Overheat protection.

.2 Low oil pressure protection.

.3 Cranking cut out.

.4 Over crank protection (3 tries).

.5 Over speed protection.

.6 Under and over frequency.

.7 Under and over voltage.

.8 Electrical fault protection.

.9 Failure to close breaker.

.10 Failure to build up voltage.

.11 All control functions.

3.4.6 Load tests:

.1 Load test the unit for 4 h at full rated load and a further 1 h at 110% rated load in ambient room temperature of 40°C. Take following data at the start of load test and every 15mins interval thereafter:

.1 Frequency.

.2 Voltage.

.3 Current.

.4 Kilowatts.

.5 Generator winding temperature.

.6 Generator frame temperature.

.7 Engine coolant temperature.

.8 Oil temperature and pressure.

.9 Manifold pressure.

.10 Ambient room temperature.

.11 Generator cooling air outlet temperature.

.12 Exciter field current and voltage.

.13 Vibration displacement.

.14 Ambient air temperature inside panel with all doors closed.

3.4.7 Miscellaneous:

.1 Provide an accurate means for determining fuel and lubricating oil consumption. Provide strip chart recorders for monitoring frequency, voltage and load. Recorder shall have a selection of speeds to allow accurate measurement of voltage, frequency and time

during the tests. The recorder shall have been calibrated by the recorder manufacturer (or designated representative) within three months of the factory testing.

3.4.8 Interpretation of ambient room temperature:

.1 Consider ambient room temperature as that temperature, which is the lowest temperature registered out of a group of three thermometers when placed in engine room as follows:

.1 One thermometer located on each side of the engine block, approximately two-thirds of the length of the block back from front (radiator) end of block, 900 mm out from block and at a height of block. A third thermometer located over end of exciter on the unit centre line, approximately 150 mm above top of exciter.

.2 Take the thermometer showing the lowest temperature to give true ambient air temperature. Adjust temperature to maintain this thermometer at 40°C during heat test.

3.4.9 Voltage and frequency regulation tests

.1 On completion of load tests take the hot resistance reading of generator windings. Subject the unit to hot voltage and frequency regulation tests for full load to no load, 4/4 load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa.

3.4.10 Panel performance and functions:

.1 Check sequence of operation under service conditions. Make provision for supplying and connecting required levels of voltage for primary circuits. Test overcurrent relays by impressing current in secondary circuits.

3.4.11 Hi-pot tests:

.1 Perform over potential tests on primary and secondary wiring in accordance with appropriate EEMAC Standard.

3.4.12 Additional tests:

.1 Perform any tests, consistent with the contract, which the Engineer may require to satisfy himself of the adequacy and satisfactory operation of the unit.

3.4.13 Supplier shall complete the forms with the requisite information pertaining to make, model and serial numbers prior to the test.

3.4.14 Supplier shall record all test data on the appendix forms, recording charts and manufacturers' test forms and be complete with diagrams and description of test results, deficiencies and corrective action. Test data sheets shall be signed by the supplier.

3.5 Shipping, Handling and Storage

3.5.1 Comply with the requirements of Section 01600 – Material and Equipment.

3.5.2 Protect the equipment against corrosion, dampness, heavy rain, etc. Also, provide adequate protection against damage or loss of components from the time the equipment leaves the

manufacturer's factory until received at the destination. Ensure packing is acceptable to the transportation companies.

3.5.3 Include heavy duty plastic sheet or bags to cover components vulnerable to construction dust. Tag this packing suitable to instruct the Contractor to leave this protection in place (where practical) until construction and clean up is complete.

3.5.4 Arrange the engine for shipment and suitably tagged with warning labels.

.1 Tag the engine sump that the lube oil to be replaced at commissioning.

.2 Tag the radiator, etc., to show that the coolant includes antifreeze.

3.5.5 Provide in each manual, a complete inventory of all spare parts, tools and accessories, a copy to accompany the shipment and a copy forwarded to the Engineer and/or Site Engineer.

3.5.6 Do not ship the equipment from the plant except by prior agreement with the Engineer and the purchaser.

3.5.7 Arrange the shipment on the transport to facilitate off-loading by the Contractor's crane or skids at the job site.

3.6 Identification

3.6.1 Refer to 16090 - Equipment Identification.

3.7 Site acceptance Testing

3.7.1 All testing identified in factory acceptance testing is to be repeated on site.

3.8 Commissioning

3.8.1 When the Contractor has completed his installation work and before any equipment is operated, he shall instruct the Supplier to commission the equipment.

3.8.2 The Supplier is to provide the services of a skilled technical representative for a minimum period of two days (16 hours) at site to carry out the following work as a minimum requirement.

.1 Check the installation as to its workmanship.

.2 Check the operation of the set as required above.

.3 Check that the operation of the engine cooling equipment is satisfactory.

.4 Check the interconnecting wiring of the engine safety devices.

.5 Perform further tests as directed the Engineer.

.6 Instruct the plant personnel in the operation and service of the equipment.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This Section describes the requirements for dry type transformers including shielded dry-type transformers and encapsulated transformers. Refer to the drawings for quantities and electrical characteristics.

1.2 Scope

1.2.1 Provide dry-type transformers as shown on the drawings and as described herein.

1.3 Related Sections

1.3.1 Section 01330 - Submittal Procedures

1.3.2 Section 16010 - Electrical General Requirements

1.3.3 Section 16090 – Equipment Identification

1.4 References

1.4.1 CSA C9, Dry-Type Transformers.

1.4.2 CSA-C22.2 No. 47, Air Cooled Transformers (Dry Type).

1.4.3 CSA-C802.2

1.4.4 Ontario Electrical Safety Code, 2021.

1.4.5 All references to be latest revision.

1.5 Quality Assurance

1.5.1 Factory tests: to CSA C9

1.5.2 Submit production test certificates for:

.1 Voltage ratio

.2 Polarity or angular displacement

.3 No load losses

.4 Load loss

.5 Impedance voltage

.6 Dielectric withstand, applied and induced

.7 Exciting current

.8 Resistance

1.5.3 Submit type test certificates and results for:

.1 Temperature rise

.2 No-load and full-load losses

.3 Sound level

.4 Radio influence voltage

.5 Positive sequence impedance

.6 Power frequency withstand test

1.6 Warranty

1.6.1 In addition to the general contract warranty, dry type transformers shall carry a ten (10) year warranty from the manufacturer.

1.6.2 The warranty shall cover repair and/or replacement from the completion of the general contract warranty period to the conclusion of the special warrantee period.

1.7 Submittals

1.7.1 Submit shop drawings in accordance with Section 01330 - Submittal Procedures. Include:

.1 Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.

.2 Technical data:

.1 KVA rating

.2 Primary and secondary voltages

.3 Three Phase

.4 Polarity or angular displacement

.5 Full load efficiency

.6 Regulation at unity PF

.7 BIL

.8 Insulation type

1.7.2 Include the following information in the Operation and Maintenance Manual:

.1 Tap changing procedure

.2 Recommended environmental conditions

.3 Recommended periodic inspection and maintenance

.4 Commissioning and startup procedure

1.8 Storage

1.8.1 Store transformers indoors in a heated, dry location.

2 PRODUCTS

2.1 Transformer Characteristic Up to 75 kVA

2.1.1 Type: ANN, Dry Type, Indoor, Convection-Cooled

2.1.2 Rating & Voltages: as indicated on drawings

2.1.3 Impedance at 115°C: standard

2.1.4 Primary and secondary coil material: Copper

2.1.5 Core material: high-grade, non-aging, silicon electrical steel

2.1.6 Angular displacement: secondary lagging primary by 30° (IEC: Dy1)

2.1.7 Voltage taps: 2 – 2½% FCAN, 2 – 2½% FCBN, silver plated. Taps to be bolted-link type and located at front of coils for accessibility

2.1.8 Insulation class: 200°C

2.1.9 Temperature Rise: 130°C

2.1.10 Provide means for securing all conductors within enclosure.

2.1.11 Efficiency: to CSA 802.2

2.1.12 Enclosure: Minimum NEMA 3R or 4X to suit environment.

2.1.13 Sound level: to CSA C9.

.1 Transformers located within or adjacent to office areas shall be quieter than the noise requirement by 5 dB.

2.1.14 Conductor entry: Side.

2.1.15 Provide anti-vibration pads or isolators between the core/coil and enclosure.

.1 Provide vibration isolators for all transformers located in or adjacent to office areas and all transformers with ratings in excess of 150 kVA.

2.1.16 Provide strip heaters for all transformers in unheated areas.

2.2 Shielded Isolation Transformers

2.2.1 As above with the following additions/modifications:

.1 Incorporate an effective electrostatic shield consisting of a single turn of copper between the primary and secondary winding and grounded to the transformer core.

2.3 Equipment Identification

2.3.1 Provide equipment identification in accordance with Section 16090.

2.4 Acceptable Products:

2.4.1 Sentinel by Hammond Power Solutions

2.4.2 Eaton/Cutler-Hammer

2.4.3 Rex

2.4.4 Polygon-Jefferson

2.4.5 Marcus

3 EXECUTION

3.1 Installation

3.1.1 Mount dry type transformers up to 75kVA as indicated. Transformers may not be mounted below lighting panels.

3.1.2 Mount dry type transformers above 75kVA on floor stands.

3.1.3 Floor mounted transformers shall have minimum 300 mm clearance between finished floor and any energized part.

3.1.4 Ensure adequate clearance around transformer for ventilation.

3.1.5 Install transformers in level upright position.

3.1.6 Protect transformer against moisture until energized. Method to be approved by Contract Administrator.

3.1.7 Remove shipping supports only after transformer is installed and just before being put into service.

3.1.8 Loosen isolation pad bolts until no compression is visible.

3.1.9 Install equipment identification.

3.1.10 Make primary and secondary connections in accordance with wiring diagrams.

3.1.11 Make drip loops in all conductors between cable entry and termination point.

3.2 Site Acceptance Testing

3.2.1 Do not test transformers until they are ready for energization.

3.2.2 Perform tests in accordance with Section 16010.

3.2.3 Test transformers in accordance with ANSI/NETA ATS-2009.

.1 Verify bolted electrical connections with calibrated torque wrench and with low-resistance ohmmeter.

.2 Apply witness marks to all verified connections.

.3 Perform turns-ratio tests at all tap positions.

3.3 Energization

3.3.1 Energize and apply load in accordance with manufacturer's instructions.

3.3.2 Energize transformers and check secondary no load voltage.

3.3.3 Verify phasing.

3.3.4 Adjust primary taps as necessary to produce rated secondary voltage at no load.

3.3.5 Check the transformer for dryness before putting into service if it has not been energized for some considerable time.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 Provide automatic, breaker-based transfer switches as shown on the drawings

1.1.2 Install transfer switch in MCC-01 for the Blind River Low Lift Pumping Station.

1.1.3 The transfer switch consists of two mechanically held switching devices, interlocking and controls necessary to alternate the supply between two sources.

1.2 Related Sections

1.2.1 Section 01330 – Submittals.

1.2.2 Section 01820 – Demonstration & Training

1.2.3 Section 16225 – Motor Control Centres

1.2.4 Section 16400 – Basic Electrical Equipment Materials

1.3 References

1.3.1 CSA C22.2 No. 178.1 Transfer Switch Equipment

1.3.2 CSA C22.2 No. 5 Moulded Case Circuit Breakers

1.4 Coordination

1.4.1 The MCC supplier shall be responsible for procurement, installation of the transfer switch.

1.5 Quality Assurance

1.5.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.

1.6 Warranty

1.6.1 Refer to the contract warrantee terms.

1.7 Submittals

1.7.1 Make submittals in accordance with Section 01330 Submittals

1.7.2 Submit drawings as part of the MCC submittal.

1.8 Operations & Maintenance Manual

1.8.1 Submit in accordance with Section 1330 Submittals.

1.8.2 Submit as part of MCC O&M manual.

1.9 Training

1.9.1 Provide training for the transfer switch during the MCC training. Demonstrate the use and maintenance of the transfer switch including emergency manual procedures.

1.10 Site Conditions

1.10.1 Refer to 16010 – General Electrical Requirements for site conditions

1.10.2 Utility & Generator supply: 600 V, 3-phase, 3-wire, solidly grounded.

2 PRODUCTS

2.1 General

2.1.1 The transfer mechanism shall be electrically operated via breakers. It shall also be capable of being operated manually and shall have suitable provisions for disengaging the gear motor when necessary.

2.1.2 The switch shall have the following positions:

.1 Connected to utility power (Source 1)

.2 Connect to generator (Source 2)

.3 Connected to no sources (Neutral)

2.1.3 The transfer switch shall be positively-mechanically-interlocked and electrically interlocked to prevent simultaneous closing of both sources.

2.1.4 The three-cycle close and withstand rating must meet or exceed the MCC rating without the use of fuses.

2.1.5 The transfer switch shall be manually operable in open-transition mode without control power.

2.1.6 Switching devices: Low Voltage Power Air Circuit Breaker with LSI protection

2.1.7 Provide current rating as shown on the drawings.

.1 The transfer switch shall be 100% rated.

2.1.8 With the exception of the incoming generator feeder cables, the 600 V power circuits shall be bus bars.

.1 Bus bars shall be tin-plated copper.

2.2 Controller

2.2.1 Provide a microprocessor-based controller including:

.1 3-phase voltage sensing on each source

.2 3 phase current sensing on each source

.3 Timing and logic to perform the desired sequence(s) of operation

.4 Local control and indication

.5 and instrumentation to control the diesel generator set and automatic transfer system.

2.2.2 Provide control power transformers on both the normal and emergency sources.

2.2.3 The controller shall be capable of initiating transfer within 5 seconds of sensing power on one source following an indefinite period of time without power.

1.1.1 Approved Product:

.1 Eaton ATC – 900 or Approved Equivalent.

2.3 Voltage and Current Sensing

2.3.1 Provide fused potential transformers to measure line-to-ground (or line-to-neutral) voltage of each phase on each source (total: 6).

.1 Accuracy: ± 2%

2.3.2 Voltage sensing relays:

.1 Provide relays to monitor the both sources of supply, of fixed settings, solid state, or relay type.

.2 Monitor all three phases.

2.3.3 Provide insulated shrouds over all bare 600 V terminals and bus.

2.4 Controls

2.4.1 Provide the following controls:

.1 Test Switch

.2 Engine Start Switch

.3 Transfer to Source 1

.4 Transfer to Source 2

.5 Disable transfer

2.4.2 Provide the following door-mounted indicator lights:

.1 Power available on utility source

.2 Power available on emergency source

.3 Position of the transfer switch

.4 Fault

.5 Controller in Auto mode

2.4.3 Provide a door-mounted display to allow the operator to toggle between the following:

.1 Active and historical faults

.2 Voltage, current and frequency for either source

.1 Show average and individual phase values.

.3 Current timer status

.4 Time & date

.5 Engine run time

.6 Set points

.7 Total number of transfers

.8 Date and time and reason of last sixteen transfers including failed attempts.

2.4.4 Provide door mounted controls to allow the operator to change setpoints.

.1 Provide a password for programming functions.

2.4.5 Provide dry contacts for customer use as shown on the drawings.

.1 Contact rating: 10A, 120 VAC.

2.4.6 Provide engine start contracts (ESC).

2.4.7 Provide pilot devices, controls, indicating lights and terminal blocks in accordance with Section 16400 Basic Electrical Equipment & Materials

2.5 Enclosure

2.5.1 The transfer switch and all associated equipment shall be housed in an MCC cubicle.

2.6 Wiring

2.6.1 Wire shall meet the requirements of 1612 - Wires & Cables 0-1000 V including type, minimum size, colour and identification, etc.

2.7 Description of Operation

2.7.1 The utility shall be considered available when the following conditions are met:

.1 All utility phase voltages are between the utility undervoltage and overvoltage setpoints, and

.2 The utility frequency is between the utility under frequency and over frequency setpoint.

.3 The phase rotation is correct

.4 The power flow is into the plant

2.7.2 The Utility shall be considered unavailable when it deviates from the above ranges by more than the corresponding time delay for that setting.

2.7.3 The generator source shall be considered available when the following conditions are met:

.1 All generator phase voltages are between the generator undervoltage and overvoltage setpoints, and

.2 The generator frequency is between the generator underfrequency and over frequency setpoint

2.7.4 The generator shall be considered unavailable when it deviates from the above ranges by more than the corresponding time delay for that setting.

2.7.5 Automatic Mode

.1 In automatic mode, upon the sensing a loss of utility, the controller shall perform the following actions in order:

.1 Wait for a programmed time delay (TDNE)

.2 Close the generator run contact

.3 Wait for the generator voltages and frequency are in the available range

.4 Wait for the generator to warm up (TDES)

.5 Open the utility source

.6 Wait for a programmed time delay (TDN)

.7 Close the generator source.

.2 Upon sensing the return of the utility source, the controller shall perform the following actions in order:

.1 Wait for a programmed time delay (TDEN)

.2 Close the utility source available contact

.3 Open the generator run contact

.4 Wait for a programmed time delay (TDN)

.5 Close the utility source.

.6 Wait for a programmed time delay (TDEC)

.7 Remove the generator run command

2.7.6 Manual operations

.1 The operator shall be able to perform the following operations at the control panel:

.1 Start/Stop generator.

.2 Perform a generator/transfer switch test by simulating a utility failure.

.3 Force immediate transfer (cancel delay timers).

.2 Where selector switches are used to switch between modes, provide a dry contact to signal that the controller is in Auto mode.

2.7.7 If the generator source fails during a test, the switch shall immediately retransfer back to the utility source.

2.7.8 The controller shall not transfer sources in the event that either the utility or generator breaker tripped on short circuit or ground fault.

2.7.9 Any automatic plant exerciser features shall be disabled.

2.7.10 Time delays:

.1 Provide relays of the motor driven, pneumatic or electronic type, adjustable to the following ranges:

.1 TDNE: 5-50 seconds. Set at 15 seconds.

.2 TDEN. 30 – 600 seconds. Set at 180 seconds.

.3 TDEC. 30 – 300 seconds. Set at 300 seconds.

.4 TDN: 5 – 60 seconds. Set at 10 seconds.

.5 TDES. 0 – 300 seconds. Set at 3 seconds.

2.8 Acceptable Automatic Transfer Switch

.1 Eaton with ATC-900 Controller

.2 Thompson Power Systems

.3 Approved Equivalent

3 EXECUTION

3.1 General

3.1.1 Install the transfer switch into the MCC in the MCC assembly plant.

3.2 Factory Testing

3.2.1 Refer to 16223 – Motor Control Centres.

3.3 Shipping, Handling and Storage

3.3.1 Protect from impact shock, vibration and moisture.

3.3.2 Install drop and humidity detectors prior to shipment to MCC manufacturer.

.1 Do not remove detectors until product arrives on site.

3.3.3 Refer to 16225 – Motor Control Centre.

3.4 Preparation for Installation

3.4.1 Refer to 16225 Motor Control Centre.

3.5 Installation

3.5.1 Refer to 16225 – Motor Control Centre.

3.5.2 Make all field terminations in accordance with 16010 – Electrical General Requirements.

3.5.3 Control wiring to generator shall be individually shielded twisted pairs.

.1 Maintain minimum 300 mm separation to AC power conductors where possible.

3.6 Identification

1.1.2 Refer to Section 16010 – Electrical General Requirements.

3.7 Site acceptance Testing

1.1.3 All testing identified in factory shall be repeated on site.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section describes miscellaneous electrical equipment and materials not covered by other sections.

1.2 General

1.2.1 All sections of Division 1 form a part of this Specification.

1.2.2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

1.2.3 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 – General Electrical Requirements related to this work

1.3 Scope

1.3.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install all equipment and materials specified herein and on the drawings.

1.4 Definitions

1.4.1 The following are definitions of terms and expressions used in the specification:

.1 “Inspection Department/Authority” means an agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site. For this project the Inspection Authority is the Electrical Safety Authority (ESA).

.2 “Electrical Code” is defined as the Ontario Electrical Safety Code, 26th edition, 2024.

.3 “Indicated” is defined as shown on the drawings or noted in contract documents.

.4 “Provide” is defined as to supply install, verify, test and commission.

1.4.2 Refer to CSA C22.2 No.0 for “Definitions and General Requirements”.

1.5 Related Sections

1.5.1 Section 01000 – General Requirements

1.6 Codes and Standards

1.6.1 Abbreviations for electrical terms: Refer to CSA Z85.

1.6.2 Ontario Electrical Safety Code latest edition and latest Bulletins of Electrical Safety Authority (ESA)

1.6.3 Building Code of Ontario, O.Reg 413, Latest Revision.

1.6.4 Local applicable codes and regulations.

2 PRODUCTS

2.1 Materials and Equipment

2.1.1 Equipment and material must be CSA certified. Where there is no alternative to supplying equipment that is CSA certified, obtain special approval from Electrical Inspection Department. Pay all associated fees and perform all required retrofits to obtain special inspection certification.

2.1.2 Factory-assemble control panels and component assemblies.

2.2 Local Control Stations

2.2.1 Control stations shall be provided as indicated on the one line diagrams or schematics or as required by the equipment furnished.

2.2.2 Pilot devices shall be heavy duty, oil tight (NEMA 13) and shall perform the functions indicated.

2.2.3 Control stations shall have the following NEMA enclosure ratings:

.1 Indoor, ordinary areas: 12

.2 Indoor, wet, damp or corrosive areas: 4X

.3 Outdoor, non-hazardous areas: 4X

2.2.4 Control stations outdoors or indicated to be weatherproof shall have protective caps on the control devices.

2.3 Control Relays (Instantaneous)

2.3.1 General purpose plug-in type relays, low coil current, heavy duty contacts with multi-contact poles as indicated.

.1 Coil rating (Vac systems): 120 V, 60 Hz.

.2 Coil rating (Vdc systems): 125 V.

.3 Contact rating (Vac systems): 120 V, 10A.

.4 Contact rating (Vdc systems): 125 V, 2A.

2.3.2 Provide overlap contact cartridges where indicated or required by the control logic. Supply in pairs having NO contact that closes before NC contact opens (early make -late break).

2.3.3 Mounting strips: indexed strips easily cut to required length and bolted in place. Relays are installed in rows on strip with captive mounting screws. Rows of relays on mounting strip form their own wiring trough.

2.3.4 Label all relays with the identifier shown on the respective control drawings. Label the relay and the panel location corresponding to the relay.

2.3.5 Acceptable Manufacturers.

.1 Omron

.2 Eaton

.3 Potter-Bromfield

.4 Allen-Bradley

.5 Or, Approved Equivalent

2.4 Timing Relays

2.4.1 General purpose electronic plug-in type relays, low coil current heavy-duty contacts with multi-contact poles as indicated. Coil rating: 120 V, 60 Hz. Contact rating: 120 V, 10A.

2.4.2 Potentiometer: self-contained to provide time interval adjustment. Timing range as indicated.

2.4.3 Where timed elements shown on drawing are not possible with a single relay, provide multiple timing relays to suit.

2.4.4 Acceptable manufacturers:

.1 Omron

.2 Eaton

.3 Potter-Bromfield

.4 Allen-Bradley

.5 Or, Approved Equivalent

2.5 Selector Switches, Indicating Lights and Push Buttons

2.5.1 All panel mounted indicating lights, LED's, selector switches and pushbutton stations unless otherwise indicated shall be 30mm Allen Bradley 800H or approved Cutler Hammer equal. Contact blocks used to switch control voltage shall be heavy duty oil-tight type silver to silver butting type contacts rated 10 amperes continuous at 120VAC. Contact configuration shall be as indicated on the drawings or as required for the application. Contact blocks used on low voltage, analog, or milliampere circuits to have gold plated contacts. For all switches, the number and arrangement of contacts and their function shall be in accordance with the schematic control diagrams indicated and shall suit the specified functional requirements. Position legends shall be engraved on the switch faceplate. Switches used in electronic signal circuits shall have contacts suitable for that duty.

2.5.2 All operator devices shall be complete with legend plate to suit application shown

2.5.3 Push Buttons:

.1 Push Buttons shall be heavy-duty, oil-tight type. Legends shall be engraved on the push-button faceplate. Contacts shall be rated 10 amperes continuous at 120VAC. Push buttons shall be Allen Bradley 800H or Cutler-Hammer "Type H".

.2 Momentary contact type: Heavy duty – oil tight, operator flush type, colour as indicated, 1-NO and 1-NC contacts rated 5A at 120V AC, labels as indicated.

.3 Push-pull contact type: Heavy duty – oil tight, operator mushroom head type, red colour, provision for padlocking in “OFF” position, 2-NO and 2-NC contacts rated 5A at 120V AC, labels as indicated.

.1 Pushbutton ratings:

.2 NEMA type 13 for indoor control panels

.3 NEMA type 4X/13 for outdoor control panels

2.5.4 Selector Switches

.1 Maintained contact type, 2 or 3 positions (as indicated), heavy duty – oil tight, operators’ standard knob, contact arrangement as indicated rated 5A at 120V AC, labels as indicated.

.2 Switch ratings:

.1 NEMA type 13 for indoor control panels

.2 NEMA type 4X/13 for outdoor control panels

2.5.5 Indicating Lights

.1 Indicating lights shall be heavy-duty, oil-tight type, with low voltage LEDs. A built-in transformer shall be used for ac service. Legends shall be engraved on the lens or on a legend faceplate. Lights shall be push-to-test type. Indicating lights shall be Allen Bradley 800H or approved Cutler Hammer "Type H".

.2 Heavy duty – oil tight, LED cluster Push-To-Test type, lens colour: as indicated, supply voltage: 120 V, labels as indicated.

.3 Indicating light ratings

.1 NEMA type 13 for indoor control panels

.2 NEMA type 4X/13 for outdoor control panels

2.6 Control Power Transformers

2.6.1 Single phase, dry type

2.6.2 Primary: as indicated, 60 Hz AC.

2.6.3 Secondary: 120V or 24V AC as indicated.

2.6.4 Rating: as indicated plus 20% spare capacity.

2.6.5 Provide secondary fuses kit (terminal block type clips) and fuse, size as indicated.

2.6.6 Transformers shall provide voltage regulation as required by magnet coils and solenoid valves.

2.7 Fire Transits

2.7.1 All cable trays, conduit etc. that transitioning through building walls, floors, ceilings to be sealed with a two (2) hour fire rated caulking or fire transit.

2.7.2 Provide shop drawing package for fire transits with data sheets and drawings indicating where each product will be used.

2.7.3 Fire transit to be ULC listed.

2.7.4 Approved Manufacturer: HILTI or Approved Equivalent.

2.8 Outdoor Underground Manholes & Handholes

2.8.1 Handhole enclosures shall be constructed of polymer concrete with fiberglass cloth reinforcement.

2.8.2 The handhole enclosures shall be a straight wall design.

2.8.3 The nominal length, width and depth dimensions shall be determined by the requirements of the application and is the responsibility of the Contractor. However, the minimum nominal dimensions for the handhole enclosure shall be:

.1 Nominal Depth: 24 inches(610 mm)

.2 Nominal Width: 17 inches (432 mm)

.3 Nominal Length: 30 inches (762 mm)

2.8.4 Load rating shall be Tier 15 as set forth by ANSI/SCTE 77 2010. Tier 15 is defined as driveway, parking lot, and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic.

2.8.5 The cover shall be securable with security bolts (five sided bolts).

2.8.6 A five-sided wrench shall be provided to the Owner for each handhole box installed.

2.8.7 Acceptable Products:

.1 Hubbell Quazite Precast Products

.2 NewBasis Composite Products

.3 Or, Approved Equivalent.

3 EXECUTION

3.1 Fire Transits

3.1.1 Install per manufacturer's approved drawings.

3.1.2 Inform contract administrator prior to installation. Contract Administrator reserves the right to witness installation.

3.1.3 Provide manufacturer's letter of proper installation for all fire transits.

END OF SECTION

1 GENERAL

1.1 Description

1.1.1 This section describes the requirements for moulded case breakers, moulded case switches, motor circuit protectors and supplementary protectors to 1000 V.

1.1.2 This section covers moulded case breakers supplied as stand-alone devices in enclosures or as part of a panelboard, MCC, control panel, or other equipment.

1.2 Coordination

1.2.1 The requirements in the section are general requirements. Specific requirements in the associated equipment section or on the drawings and code requirements shall supersede these requirements.

1.3 Related Sections

1.3.1 Section 01330 – Submittals

1.3.2 Section 16010 – Electrical General Requirements

1.3.3 Section 16225 – Motor Control Centres

1.3.4 Section 16441 – Panel Boards Breaker Type

1.4 References

1.4.1 CSA C22.2 No.5 Moulded Case Circuit Breakers.

1.4.2 CSA C22.2 No. 235 Supplementary Protectors

1.4.3 NEMA AB-1.

1.5 Quality Assurance

1.5.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.

1.5.2 The supplier shall be responsible for ensuring that all breakers supplied as part of that equipment are installed in accordance with the manufacturer's instructions.

1.6 Submittals

1.6.1 Provide submittals related to this section with the related equipment.

1.6.2 Submit product data in accordance with Section 01330 - Submittal Procedures.

.1 Include time current characteristic curves for breakers rated over 400 A.

1.7 Training

1.7.1 The contractor shall provide training for all breakers with electronic or adjustable trip settings.

1.7.2 Training shall be provided as part of the training for the associated equipment.

1.8 Site Conditions

1.8.1 Refer to associated equipment section.

2 PRODUCTS

2.1 General

2.1.1 All breakers shall be bolt-on type unless otherwise indicated.

2.1.2 The equipment supplier shall provide appropriately de-rated breakers where the ambient temperature will exceed 40 °C

2.1.3 Polyphase breakers shall be a single unit with a common type and a single handle for all poles.

2.1.4 Circuit breakers shall be operated by a toggle type handle and shall have a quick make, quick break over centre switching mechanism that is mechanically trip free.

2.1.5 Automatic tripping of the breaker shall be clearly indicated by the handle position.

2.1.6 Visual Verification:

.1 Where indicated on the drawings and/or any breakers that are key interlocked, provide a clear viewing window in the front of the breaker case to suit visual verification of contact positions as required to suit Ontario Electrical Safety Code. Contacts are to be painted with a bright colour to enhance the contracts and contact positions.

.2 Provide a clear window in the respective SWGR, MCC and/or Panel board to allow for breaker contact visual verification.

2.2 Moulded Case Breakers for AC Systems

2.2.1 Moulded case breakers shall be listed to CSA C22.2 No. 5.

2.2.2 All breakers shall be thermal-magnetic moulded case breakers unless otherwise noted on the drawings or in the equipment specifications or where required by the equipment.

2.2.3 Breakers shall be fully coordinated with the exception of redundant breakers such as feeder breakers feeding a single control panel with a main breaker.

.1 Series-rated breakers are not acceptable.

2.2.4 Where available short circuit currents exceed rating of standard thermal magnetic breakers range, provide a current limiter.

2.2.5 Where indicated on the drawings and/or any breakers that are key interlocked, provide a clear viewing window in the front of the breaker case to suit visual verification of contact positions as required to suit Ontario Electrical Safety Code. Contacts are to be painted with a bright colour to enhance the contracts and contact positions.

.1 Provide a clear window in the respective MCC and/or Panelboard to allow for breaker contact visual verification.

2.2.6 Minimum symmetrical interrupting capacity where not indicated on the drawings

.1 120/240 VAC Breakers: 10 kA

.2 600 VAC breakers: 42 kA.

2.2.7 Unless otherwise indicated, breakers up to 250 AF (‘J’ Frame) shall have:

.1 Listed for use at 100% of their continuous ampere rating in the supplied enclosure.

.2 Factory installed, non-interchangeable thermal-magnetic trip units, except:

.1 Provide trip units with adjustable short time delay for breakers feeding panelboards or distribution equipment.

2.2.8 400 AF (‘K’ Frame) and larger circuit breakers shall be:

.1 Listed for use at 100% of their continuous ampere rating in the supplied enclosure

.2 Equipped with electronic trip units

2.2.9 Special Purpose Breakers

.1 Provide moulded case switches where indicated.

.2 Breakers for DC circuits shall be clearly marked as suitable for DC circuits.

.3 Breakers mounted on equipment with high vibration or shock loading shall be Naval rated.

.4 Breakers exposed to ambient conditions below 0 °C including all breakers in outdoor panels shall be rated to -40 °C.

.5 Breakers mounted on generator breakers shall be listed for the purpose.

2.2.10 Acceptable Products

.1 ABB Tmax

.2 Eaton Series ‘C’ or ‘G’

.3 Rockwell Bulletin 140 U (systems with fault current to 50 kA only)

.4 Siemens Sentron or VL

.5 Schneider Powerpact

.6 Or, Approved Equivalent

2.3 Thermal Magnetic Breakers

2.3.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.4 Magnetic Breakers

2.4.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.5 Current Limiting and Series Rated Thermal Magnetic Breakers

2.5.1 Thermal magnetic breakers with current limiters.

.1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.

.2 Co-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.

2.5.2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.

.1 Breakers applied following manufacturer's guidelines and accepted best practice.

2.6 Solid State Trip Breakers

2.6.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and instantaneous tripping for phase and ground fault short circuit protection.

2.7 Additional Features

2.7.1 Include:

.1 Shunt trip.

.2 Auxiliary switch.

.3 Motor-operated mechanism [c/w time delay unit].

.4 Under-voltage release.

.5 On-off locking device.

.6 Handle mechanism.

2.8 Enclosure

2.8.1 Individual wall mounted breakers to be installed in an enclosure complete with a hinged door and a lockable external breaker handle.

.1 Refer to Section 16010 – Electrical General Requirements for enclosure requirements.

2.9 Spare parts and accessories

2.9.1 Provide terminal covers for all main breakers.

2.9.2 Provide short circuit trip auxiliary contacts for breakers ahead of transfer switches.

3 EXECUTION

3.1 Shipping, handling and storage

3.1.1 Protect all breakers from impact and moisture.

3.2 Installation

3.2.1 Install circuit breakers as indicated.

3.2.2 Circuit breakers are to be installed into equipment at the factory. Field assembly of breakers into equipment is not acceptable unless explicitly requested on the drawings or in the specifications.

3.2.3 Ensure that equipment containing circuit breakers will not be exposed to temperatures outside the manufacturers design temperature.

3.2.4 Circuit breakers shall be located to allow clear view of the line and load terminals with an infrared scanning camera.

3.2.5 Adjust trip unit settings for all breakers based on short circuit & coordination study.

3.2.6 100 % Rated breakers

.1 Wire insulation for 100% rated breakers must be 90 °C minimum.

3.2.7 DC Breakers

.1 Wire DC breakers poles in series as required by the manufacturer's instructions.

3.3 Identification

3.3.1 All breakers shall be identified to match the equipment supplier's approved shop drawings.

END OF SECTION

1 GENERAL

1.1 Description of Work

1.1.1 Provide circuit and equipment disconnect switches as indicated on the drawings and as required by code. Each motor shall include a local disconnect adjacent to the motor.

1.2 Related Sections

1.2.1 Section 01330 – Submittals

1.2.2 Section 16090 – Equipment Identification

1.3 Product Data

1.3.1 Submit product data in accordance with Section 01330- Submittals.

1.3.2 Submit manufacturer's data for all disconnect switches.

1.3.3 Identify motor or equipment served by each switch; indicate nameplate inscription.

2 PRODUCTS

2.1 Disconnect Switches

2.1.1 Supply and install heavy duty safety switches, fused or unfused, as required complete with fuses as shown or required by code. Safety switches shall be quick make and quick break construction with safety interlock and HP ratings as indicated.

2.1.2 Switches located in process areas shall at minimum be enclosed in a NEMA Type 4X housing.

2.1.3 Provision for padlocking in off switch position by one (1) lock.

2.1.4 Mechanically interlocked door to prevent opening when handle in ON position.

2.1.5 Provide fuse performance, rating and type as recommended by the protection coordination study.

2.1.6 Fuse holders: re-locatable and suitable without adaptors, for type and size of fuse indicated.

2.1.7 Quick-make, quick-break action.

2.1.8 ON-OFF switch position indication on switch enclosure cover.

2.1.9 Switches shall be fitted with a label to indicate switch voltage (e.g. 120C, 600V, etc.) in accordance with ESA requirements.

2.1.10 Disconnect switches to be equipped with auxiliary status position contacts to suit switch position. Auxiliary contacts shall be suitable for use with VFD applications. Contacts shall be late make, early break type.

2.2 Equipment Identification

2.2.1 Provide equipment identification in accordance with Section 16090 – Equipment Identification.

2.3 Acceptable Manufacturer

2.3.1 Cutler Hammer

2.3.2 Hubbell

2.3.3 Cooper Crouse – Hinds

2.3.4 Square 'D'

2.3.5 Or, Approved Equivalent

3 EXECUTION

3.1 Installation

3.1.1 Install disconnect switches complete with fuses if applicable.

3.1.2 Provide corrosion resistant mount hardware, and stands for free standing disconnect installations.

3.1.3 Wire all disconnect switch auxiliary status contacts into the respective motor starters as required.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 The Contractor shall provide and install the panel-boards as specified and as shown on the contract drawings.

1.1.2 Provide directory cards for all panel boards; i.e. power, lighting, low voltage systems, communications, etc.

1.2 Related Sections

1.2.1 Section 01330 – Submittals

1.2.2 Section 16010 – Electrical General Requirements

1.3 References

1.3.1 CSA C22.2 No.29-M1989 (R2000) Panel-boards and Enclosed Panel-boards.

1.4 Product Data

1.4.1 Submit shop drawings in accordance with Section 01330 – Submittal Procedures.

1.4.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.5 Submittals

1.5.1 The following information shall be submitted to the Contract Administrator:

.1 Breaker layout drawing with dimensions indicated and nameplate designation

.2 Circuit designations for all branch breaker applications and including spare breakers

.3 Component list

.4 Conduit entry/exit locations

.5 Assembly ratings including:

.1 Short circuit rating

.2 Voltage

.3 Continuous current

.6 Cable terminal sizes

.7 Product data sheets

.8 Key interlock scheme drawing and sequence of operations where applicable

1.6 Submittals – For Construction

1.6.1 The following information shall be submitted for record purposes:

.1 Final as-built drawings and information for items listed in paragraph 1.4 – Product Data

.2 Installation information

1.6.2 The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.7 Qualifications

1.7.1 The manufacturer of the panel-board shall be the manufacturer of the major components within the assembly including circuit breakers and fusible switches.

1.7.2 The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

.1 The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.

.2 The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

.3 The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.8 Regulatory Requirements

1.8.1 The panel boards shall be CSA labelled.

1.9 Delivery, Storage, and Handling

1.9.1 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 Operation and Maintenance Manuals

1.10.1 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewals parts lists where applicable, for the complete assembly and each major component.

2 PRODUCTS

2.1 Panel boards

2.1.1 Panel boards: product of one (1) manufacturer.

.1 Install circuit breakers in panel-boards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

2.1.2 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

2.1.3 Panel-boards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

2.1.4 Two (2) keys for each panel-board and key panel-boards alike.

2.1.5 Copper bus with neutral of same ampere rating as mains.

2.1.6 Mains: suitable for bolt-on breakers.

2.1.7 Trim with concealed front bolts and hinges.

2.1.8 Trim and door finish: baked grey enamel.

2.2 Custom Built Panel-board Assemblies

2.2.1 125mm relay section on both sides of panels as indicated for installation of low voltage remote control switching components.

2.2.2 Double stack panels as indicated.

2.2.3 Contactors in mains as indicated.

2.2.4 Feed through lugs as indicated.

2.2.5 Isolated ground bus.

2.3 Breakers

2.3.1 Breakers: to Section 16412 – Moulded Case Circuit Breakers.

2.3.2 Breakers with thermal and magnetic tripping in panel boards except as indicated otherwise.

2.3.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

2.3.4 All breaker applications shall include the provision for lockout capability. The lockout feature shall accommodate a safety tag that can be lockout out via a safety pad lock.

2.4 Equipment Identification

2.4.1 Provide equipment identification in accordance with Section 16090 – Electrical Identification.

2.4.2 Provide engraved nameplate for each circuit in 600 V panel-boards.

2.4.3 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.5 Ratings

2.5.1 Panel-boards rated 208 V AC or less shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 22,000 amperes RMS symmetrical.

2.5.2 Panel-boards rated 600 V AC shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 42,000 amperes RMS symmetrical.

2.5.3 Series ratings are not acceptable unless explicitly shown on drawings.

2.6 Construction

2.6.1 Interiors shall be completely factory assembled devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

2.6.2 Trims for branch circuit panel-boards shall be supplied with a hinged door over all circuit breaker handles. Doors in panel-board trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners.

2.6.3 Distribution panel-board trims shall cover all live parts. Switching device handles shall be accessible.

2.6.4 Surface trims shall be same height and width as box. Flush trims shall overlap the box by 20 mm on all sides.

2.6.5 A directory with a clear plastic cover shall be supplied and mounted on the inside of each door.

2.6.6 All locks shall be keyed alike.

2.7 Bus

2.7.1 Main bus bars shall be copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65°C above an ambient of 40°C base.

2.7.2 A system and insulated/isolated ground bus shall be included in all panels.

2.7.3 Full size (100% rated) insulated neutral bars shall be included for panel boards shown with neutral. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200% rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.8 Branch Circuit Panelboards

2.8.1 The minimum short circuit rating for branch circuit panel-boards shall be as specified herein or as indicated on the drawings. Panel-boards shall be fully rated.

2.8.2 Bolt on type, heavy duty, quick make, quick break, single and multi pole circuit breakers of type specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.

2.8.3 Circuit breakers shall be thermal magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100 ampere frame and through 100 ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be ULC listed as type SWD for lighting circuits.

.1 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

2.8.4 Circuit breakers shall have a minimum interrupting rating of 22,000 amperes symmetrical at 208 V, and 42,000 amperes symmetrical at 600 V, unless otherwise noted on the drawings.

2.9 Surge Protective devices

2.9.1 Provide surge protective devices in accordance with Section 16671 and as shown on drawings.

2.10 Enclosure

2.10.1 Enclosure shall be at least 500 mm wide made from galvanized steel. Provide minimum gutter space in accordance with the Ontario Electrical Safety Code, 2024. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four (4) interior mounting studs with adjustable nuts shall be provided.

2.10.2 Enclosure shall be provided with blank ends.

2.10.3 Where indicated on the drawings, branch circuit panel-boards shall be column width type.

2.11 Approved Products

2.11.1 Cutler Hammer – Power R Line

2.11.2 General Electric

2.11.3 Schneider Electric

2.11.4 Siemens

2.11.5 Approved Equivalent

3 EXECUTION

3.1 Factory Testing

3.1.1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of CSA standards.

3.2 Related Installation

3.2.1 Locate panel-boards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

3.2.2 Install surface mounted panel boards on plywood backboards. Where practical, group panel-boards on common backboard.

3.2.3 Mount panel boards to height specified in Section 16010 – Electrical General Requirements or as indicated.

3.2.4 Connect loads to circuits.

3.2.5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 Panelboards Schedules

3.3.1 Contractor shall provide panel schedules for each panel board.

3.3.2 Each panel schedule card shall have clearly typed information as with the following example:

.1 Panel Name …. Example: LP-A

.2 Panel Voltage …120/208 V

.3 Panel Supply …. 200 A

3.3.3 All systems distribution cabinets shall be complete with a directory card showing circuit numbers, room locations, and a blank column for "REMARKS".

3.3.4 Temporary panel directory cards shall be provided and filled in as the circuits are installed. The temporary directory card shall be replaced with a typed permanent directory at job completion.

3.3.5 The panel directory card shall be inserted in the card holder on the inside of the panel door and be protected by a clear plastic sheet.

3.4 Load Balance

3.4.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

3.4.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

3.4.3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

END OF SECTION

1 GENERAL

1.1 Related Sections

1.1.1 Section 16010 – Electrical General Requirements

1.2 References

1.2.1 American National Standards Institute (ANSI)

.1 ANSI C82.1-1995, Specifications for Fluorescent Lamp Ballasts.

.2 ANSI C82.4-1992, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.

1.2.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41-1991, Recommended Practices for Surge Voltages in Low-Voltage AC Power Circuits.

1.2.3 American National Standards Institute/Illuminating Engineering Society (ANSI/IES)

.1 ANSI/IES 501, Installing Exterior Lighting Systems

1.2.4 American Society for Testing and materials (ASTM)

.1 ASTM F1137-88(1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

1.2.5 IEC SC 34C 62384 – DC or AC supplied electronic control gear for LED modules

1.2.6 EC SC 34A – Performance Standard for LED Lamps

1.2.7 C22.2 No. 250.0 – Luminaires

1.2.8 UL 8750 LED Light Sources for Use in Lighting Products

1.3 Submittals

1.3.1 Submit shop drawings in accordance with Section 01330 – Submittal Procedures.

1.3.2 Submit complete photometric data prepared by independent testing laboratory for luminaries for approval by the Contract Administrator.

1.3.3 Submit product data and/or wiring schematics for lighting control systems.

1.3.4 Submit the following shop drawings, information and data:

.1 All Luminaires

.1 Catalogue data sheets and pictures.

.2 Luminaire finish and metal gauge.

.1 Upon request, provide colour chips showing colour and texture.

.3 Lens material, pattern, and thickness.

.4 Lumen distribution curves in two or more planes

.5 Photometric (.ies) files.

.6 Average & maximum brightness data.

.7 Dimensions, weights and mounting or suspension details.

.8 Upon request, provide luminaire sample for review and return.

.2 Exterior Luminaires

.1 IESNA lighting classification and isolux diagram (exterior fixtures only).

.2 Pole wind/ice loading and reaction forces.

.3 Pole anchoring and erection details

.3 Additional Data for LED luminaires

.1 LED and driver operating temperature for each luminaire and system life expectancy at the expected temperature.

.2 Lumen maintenance per IES LM80–08 to L70 (70% of initial lumens).

.3 Photometry data per IES LM–79.

.4 Lamps

.1 Voltages.

.2 CRI, CCT.

.3 Approximate life (in hours).

.4 Approximate initial lumens.

.5 Lumen maintenance curve.

.6 Lamp type and base.

.5 Ballasts

.1 Type.

.2 Wiring diagram.

.3 Nominal watts and input watts.

.4 Input voltage and power factor.

.5 Starting current, line current, and restrike current values.

.6 Sound rating.

.7 Temperature rating.

.8 Efficiency ratings.

.9 Lower temperature characteristics.

.10 Emergency ballasts rating and capacity data.

.11 Upon request, provide heat-run data.

1.4 Quality Assurance

1.4.1 Standards

.1 All fixtures shall be CSA approved and shall be so labelled.

.2 All ballasts shall meet ANSI standards C82.4 and CSA specifications C22.2 No. 74 as applicable

.3 Outdoor fixtures are to be compliant to IESNA RP-33-99 for dark skies.

1.5 Operations and Maintenance Manuals

1.5.1 Information to include:

.1 Parts list complete with parts ordering identification numbers.

.2 Reviewed shop drawings.

.3 Service Manuals.

.4 Recommended maintenance procedures and schedules.

.5 Equipment operating procedures.

.6 Descriptive and technical data for all supplied components.

.7 Schematic diagrams.

.8 Wiring diagrams.

.9 Trouble shooting guide.

2 PRODUCTS

2.1 General Details of Fixtures

2.1.1 All lighting fixtures shall be provided in accordance with the schedule or legends listed on the contract drawings.

2.1.2 The finish and colour of all fixtures shall be approved by the Contract Administrator.

2.1.3 Fixtures shall be complete with necessary hardware, brackets, pre-wired terminals, etc.

2.1.4 All fixtures shall be complete with the approved type of lamp, suitable to the fixture with correct shape, voltage, wattage, life rating, etc., as indicated in the schedule or otherwise approved by the Contract Administrator.

2.1.5 Fixtures, ballasts/drivers and lamps shall be “Restriction of Hazardous Substances” (RoHS) compliant where available.

2.1.6 All metal halide fixtures shall be equipped with protective lenses.

2.1.7 All fixture types designed with adequate heat sinks to dissipate the generated heat in order to prevent ballast and lamps from overheating with the resulting decrease in their rated life expectancy and/or light output. Fixtures to be wired with type GTF fixture wire.

2.1.8 All fixtures shall be complete with required safety disconnect means.

2.1.9 All interior and exterior fixtures to be minimum NEMA 4X fixtures unless otherwise noted.

2.2 Lamps

2.2.1 LED Lamps shall be 4000°K CCT, minimum lamp life of 50,000 hours based on IESNA LM80–08 for the associated luminaire, minimum CRI of 80, Lumens per Watt/Efficacy greater than 70

2.2.2 All lighting products shall be Design Lights Consortium (DLC) qualified to the latest version of DLC technical requirements.

2.2.3 Manufacturer’s warranty for all lighting products shall be 5 year minimum.

2.3 LED Drivers

2.3.1 Provide an electronic power supply / LED driver to regulate the power requirements of the LED light. The low ambient operating temperature limit for the total luminaire is -40 to +50ºC.

2.3.2 Provide passive cooling to suit all LED fixtures. Provide heat sinks and air convection to cool the respective fixture. Coordinate the installation of recessed fixtures to ensure adequate passive cooling.

2.3.3 Power supplies and control interfaces shall be compatible with the LED modules/luminaires.

2.3.4 Dimming controls shall be compatible and tested with LED luminaires.

2.3.5 Where dimming applications are required, coordinate with the LED luminaire manufacturer to ensure compatible dimmers/dimming systems are provided.

2.4 Outdoor Lighting

2.4.1 Provide outdoor lighting fixtures as indicated on the drawings. Unless the photocell is integral to the light fixture, provide photo cell controls for outdoor light fixture. Provide a dedicated photo cell and mount as required. Provide a photocell override switch to facilitate testing of the outdoor lighting.

2.4.2 Provide full-cut off, dark-sky approved fixtures for outdoor locations.

2.4.3 For pole lighting applications, provide a 20ft aluminum non-tapered square pole with concrete base. Luminaire arm to be aluminum and length/span to be such that fixture is place directly above the curb or as shown on the contract drawings. Provide shop drawings that indicate dimensions for both pole and arms.

2.4.4 Photocell Controller Unit (if required):

.1 Calibration setpoints shall be adjustable and units of measurement shall be foot-candles.

.2 Adjustable foot-candle setpoints shall be provided for both high- and low-trip to create a dead band.

.3 The unit shall have an activation time delay feature that is switch-enabled and provides a delay of 3 minutes.

.4 The unit shall be equipped with, at minimum, one (1) normally open relay contact. The relay contact to close when light level falls below 1 foot candle.

.5 The unit shall be equipped with a master switch input for temporarily overriding all outputs either to ON or OFF.

.6 See drawings for more details.

2.4.5 Photo cell operating temperature: -40 degrees C to 80 degrees C

2.5 Spares

2.5.1 Provide the following spare parts:

.1 Lamps, LED and induction: 5% of each type, minimum one (1).

.2 Lenses: 10 % of each type

2.5.2 Where LED luminaires cannot be disassembled and individual components replaced, provide 5% spare luminaires (minimum 2).

3 EXECUTION

3.1 Installation of Fixtures, General

.1 Mounting details and elevations shall be as generally indicated but the Contractor shall be responsible to ensure that the type of fixture mounting, especially with recessed fixtures, suits the type of ceiling and is complete with all necessary fittings, plaster frames or rings, etc., to ensure a neat and satisfactory installation. The model numbers are generic and should be finalized by the contractor based on mounting option requirements in accordance with the lighting vendor recommendations. Mounting brackets and related equipment shall be provided at no extra cost to the Owner. The mounting details will not be reviewed during the shop drawing review and should be the responsibility of the contractor to coordinate with other trades and the lighting vendor.

.2 The exact location of all surface mounted and recessed fixtures shall be coordinated with the other trades. Suspended fixtures shall be located to clear piping and duct work and, particularly in equipment areas, installed after the completion of mechanical and process work to best suit the available space.

.3 The contractor shall relocate, at no cost to the Owner, any fixture obstructed by piping or other mechanical or process feature where the obstruction is due to improper coordination.

.4 Protect fixtures from damage during construction and replace any fixtures, lens or lamps showing damage.

.5 Fixtures shall be installed per manufacturer's directions. Include safety chains, mounting hardware as required

.6 Install fixtures to minimize interference with operations and maintenance of the facility.

3.2 Installation of Outdoor Fixtures

3.2.1 Aim all outdoor fixtures to prevent light spill and direct glare to adjacent properties.

3.3 Wiring and Connections:

3.3.1 All necessary wiring, conduit outlet boxes, connections and power supplies shall be provided to suit the system offered in accordance with manufacturer's requirements for minimum wire sizes and amperage loads.

3.4 Inspection

3.4.1 Prior to installation of the work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

3.4.2 Verify that electrical equipment is installed in strict accordance with all pertinent codes and regulation, the reviewed shop drawings, and the original design.

END OF SECTION

1 GENERAL

1.1 References

1.1.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.141, Emergency Lighting Equipment.

.2 CSA C860, Performance of Internally Lighted Exit Signs.

1.1.2 National Fire Protection Association (NFPA) requirements

1.1.3 Ontario Electrical Safety Code, 29th Edition, 2024.

1.2 General

1.2.1 Provide emergency light fixtures rated to area classification.

1.3 Submittals

1.3.1 Submit product data in accordance with Section 01330 – Submittal Procedures.

1.3.2 Submit product data sheets for exit signs. Include product characteristics, performance criteria, physical size, limitations and finish.

1.3.3 Provide Manufacturer's Instructions to indicate special handling criteria and installation sequence.

2 PRODUCTS

2.1 Exit Signs

2.1.1 The finish and colour of all units shall be approved by the Contract Administrator.

2.1.2 All exit signs shall have LED illumination.

2.1.3 Exit signs shall be the pictogram (i.e. green – "running man") for all exit signs to be installed throughout the low lift pump station.

2.1.4 Obtain confirmation of the required symbology prior to submittal of shop drawings.

2.1.5 Exit signs shall be wall or ceiling mounted as required.

2.1.6 Provide all required wiring and conduits from the lighting panel and/or exit sign battery pack to the exit signs. Exit signs are to be powered by the emergency lighting battery unit as detailed in Section 16536 – Emergency Lighting Units.

2.1.7 Products (unless indicated on the drawings)

.1 Durable extruded, one-piece aluminum housing and face plates

.1 Approved product:

.1 Lumacell, Thomas&Betts, Emergi-Lite – EN Series and ENC series or Approved Equivalent.

2.1.8 Integral lamp heads: Where required and indicated on the contract drawings.

.1 Two, integral on unit

.2 Lamp type: MR16 LED, 12VDC, 6 Watts

2.1.9 Integral Battery: Where required and indicated on the contract drawings.

.1 Battery: Sealed, maintenance free with ten (10) year design life

2.1.10 Provide battery capacity to ensure that the application complies with all code requirements for maximum permissible voltage drop.

3 EXECUTION

3.1 Installations

3.1.1 Install exit signs at all locations shown on the drawings.

3.1.2 Provide new circuit breakers in the lighting panels indicated in the drawings. Wire and connect the exit signs or the related battery units directly to these circuit breakers. Other loads that are unrelated to the exit sign or emergency lighting systems shall not be connected to these breakers.

3.1.3 Where necessary to clear obstructions, pendant mount exit signs in service rooms and other areas. Install suspended exit signs using pendants supported from swivel hangers.

END OF SECTION

1 GENERAL

1.1 Section Includes

1.1.1 Materials and installation for emergency lighting systems.

1.2 Scope

1.2.1 Provide complete emergency lighting system including battery units, chargers, remote heads including wiring, conduits and receptacles as required. Setup and test installed system and provide verification report and list of deficiencies.

1.3 Related Sections

1.3.1 Section 01330 – Submittal Procedures.

1.3.2 Section 16122 – Wire and Cables 0-1000V.

1.3.3 Section 16132 - Outlet Boxes, Conduit Boxes and Fittings

1.3.4 Section 16133 – Conduits, Conduit Fastenings and Conduit Fittings

1.4 References

1.4.1 Canadian Standards Association (CSA International), CSA C22.2 No. 141, Unit Equipment for Emergency Lighting.

1.4.2 Ontario Electrical Safety Code, 29th Edition, 2024

1.5 General

1.5.1 Provide emergency lighting products that are rated in accordance with the area classification.

1.5.2 Coordinate the size of the battery pack and wiring to ensure 30 min continuous operation, with less than 3% voltage drop at the terminals of the exit light fixture

1.6 Submittals

1.6.1 Submit product data in accordance with Section 01300 – Submittals

1.6.2 Data to indicate system components, mounting method, source of power and special attachments.

1.7 Waste Management and Disposal

1.7.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.7.2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material, in appropriate on-site bins, for recycling in accordance with Waste Management Plan.

1.7.3 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Contract Administrator.

1.7.4 Dispose of unused batteries at official hazardous material collections site approved by Contract Administrator

1.7.5 Fold up metal banding, flatten and place in designated area for recycling.

2 PRODUCTS

2.1 Equipment

2.1.1 For each emergency lighting unit, provide a 120 VAC receptacle in a location adjacent to the unit that will allow the unit to be plugged into the outlet.

2.2 Battery Units

2.2.1 Lamp heads: Two, integral on unit, Lamp type: MR16 LED, 24 VDC, 6 Watts

2.2.2 Charger:

.1 Automatic, solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.

.2 Supply voltage: As indicated on drawings.

.3 Output voltage: 24 VDC.

.4 Solid state transfer circuit

.5 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.6 LED signal lights: ‘AC Power ON’, ‘High Charge’.

.7 Test switch, Auto Self-test and Auto diagnostic with diagnostic LED indicator light for Battery Failure and unit Service alarm (General Alarm).

.8 DC fused block shall be provided for load circuits together with conduit entry.

2.2.3 Battery

.1 Capacity: as shown on drawings.

.2 Operating time: 30 minutes (minimum)

.3 Battery: Sealed, maintenance free with ten (10) year design life

2.2.4 Provide battery capacity to ensure that the application complies with all code requirements for maximum permissible voltage drop.

2.2.5 Enclosure

.1 Rugged steel cabinet with corrosion-resistant undercoating Approved product:

.1 Lumacell, Emergi-Lite series or approved equal.

.2 Colour: White

2.3 Remote Heads

2.3.1 Single or double head(s), complete with mounting plates, 300 degree horizontal and 80 degree vertical minimum adjustment.

2.3.2 Lamps: MR16 LED, 24 VDC, W or as shown on drawings.

2.3.3 Input voltage: match associated battery unit.

2.3.4 Mounting: ceiling or wall as shown.

2.3.5 Finish: white painted.

2.3.6 Provide white metal wire guard as required.

2.3.7 Products:

.1 UV resistant fire retardant Die-Cast polycarbonate back plate and a clear heavy-duty UV resistant polycarbonate light cover Approved product: Lumacell, Emergi-Lite –series or approved.

3 EXECUTION

3.1 Installation

3.1.1 Each emergency light unit shall be shelf mounted 2.4m above finished floor.

3.1.2 Install all unit equipment, remote heads, exit signs, and accessories in accordance with manufacturer's instructions.

3.1.3 Install unit equipment and associated receptacle.

3.1.4 Verify the appropriate branch circuit serving the lighting in the area. Wire and connect unit to that branch circuit.

3.2 Testing and Verification

3.2.1 Arrange with the manufacturer to conduct a complete inspection and test of all installed emergency lighting system. Testing shall be witnessed by the Engineer.

3.2.2 Manufacturer's representative shall properly aim remote heads, record the light level readings, record battery full load operation time and issue a verification letter indicating that the system has been installed properly.

3.2.3 Submit verification report to Engineer including measurements, calculated values and list of deficiencies.

END OF SECTION

1 GENERAL

1.1 Scope

1.1.1 Provide surge protective devices (SPDs) as shown in the contract drawings and specifications.

.1 The Contractor shall supply, and side mount install the Surge Protective Devices (SPD) on the 120/208V panel boards indicated in the contract drawings, in accordance with the SPD manufacturer's installation instructions and the requirements herein.

.2 The Contractor shall supply the Surge Protective Devices (SPD) to the manufacturers of the 600V panel boards, 600V SWGRs, and 600V MCCs indicated in the contract drawings. The manufacturers of the 600V panel boards and 600V MCCs shall install the SPDs in accordance with the SPD manufacturer's installation instructions and the requirements herein.

1.2 References

1.2.1 The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:

.1 Underwriters Laboratories, UL 497, 497A, 497B, 1283, ANSI/UL 1449

.2 Institute of Electrical and Electronic Engineers, ANSI/IEEE C62.11, C62.41, C62.45

.3 Canadian Standards (CUL, CSA)

1.3 Submittals

1.3.1 Provide verification that all devices are listed to ANSI/UL 1449 (latest edition) and relevant CSA standards.

1.3.2 Product Data: Provide catalog sheets showing

.1 Nominal system voltage and phases

.2 Modes of protection

.3 Maximum continuous operating voltage (MCOV) and temporary operating voltage (TOV) per mode

.4 Voltage Protection Rating (VPR) per ANSI/UL 1449 for each required waveform

.5 Nominal Discharge Current (I_n) and peak surge current per mode and per phase

.6 Graphs of insertion loss for all EMI/RFI filters.

.7 Modes of discrete suppression circuitry,

.8 Output contacts (where applicable)

.9 Physical size, lifting and support points, enclosure details

.10 Warranty period and replacement terms,

1.3.3 Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product. Indicate maximum size of circuit breaker or fuse to be connected for each unit, permissible conductor size, conductor type and lead length to achieve the stated protection characteristics.

1.3.4 Shipping, storage and handling instructions.

1.3.5 Where devices are equipped with surge counters and/or failure alarms, provide a description of their operation citing all actual values for operation.

1.3.6 List and detail all protection systems such as fuses, disconnecting means and protective features.

1.4 1.4 Submittals – For Construction

1.4.1 The following information shall be submitted for record purposes:

.1 Final as-built drawings and information for items listed in paragraph 1.4 - **Error! Reference source not found.**.

1.4.2 The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.5 Qualifications

1.5.1 The panel mounted SPD and supporting components shall be guaranteed by the manufacturer to be free of defects in material and workmanship for a period defined within this specification. The warrantee shall commence from the date of substantial completion of service and activation of the system to which the suppressor is attached. Any additional diagnostic circuits (LEDs, surge counter, etc.) must meet a warranty period of ten (10) years.

1.5.2 The installation of SPDs in or on electrical distribution equipment shall in no way compromise or violate equipment listing, labeling, or warranty of the distribution equipment.

1.6 Operation and Maintenance Manuals

1.6.1 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewals parts lists where applicable, for the complete assembly and each major component.

2 PRODUCTS

2.1 General

2.1.1 All SPD assemblies and components shall be CSA and/or ULC approved.

2.1.2 Enclosure ratings shall meet or exceed the rating of the equipment it is attached to.

2.1.3 The SPD shall be maintenance-free with hardwired components.

2.1.4 Internal Fusing - Overcurrent Protection

.1 Each Metal Oxide Varistor or other primary suppression component shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses.

.2 Fusing shall be present in every mode, including Neutral-to-Ground.

2.1.5 All SPDs shall be equipped with a comprehensive monitoring system providing clear indication when the unit is functioning properly and, in the event of loss of protection, clear indication that protection has been lost and which phase has been lost.

2.1.6 The SPD shall include Form C dry contacts (N.O. or N.C.) for remote monitoring capability unless otherwise indicated.

2.1.7 The SPD shall have an internal audible alarm with mute on front cover unless otherwise indicated.

2.1.8 All internal power connections shall be as short and straight as possible and shall be designed to minimize inductance.

2.2 Powerline Surge Protective Devices

2.2.1 Powerline (60 Hz) SPDs shall protect all modes L-G, L-N, L-L, and N-G, have discrete suppression circuitry in L-G, L-N and N-G, and have bidirectional, positive and negative impulse protection. Line-to-neutral-to-ground protection is not acceptable where line-to-ground is specified, and accordingly reduced mode units with suppression circuitry built into only 4 modes are not acceptable.

2.2.2 The disconnect switch or breaker (when specified) and the SPD as a system shall meet or exceed the fault interrupting and withstand ratings of the equipment it is attached to.

2.2.3 All SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.2.4 Type 2 SPDs shall include UL 1283 listed EMI/RFI filters.

2.2.5 EMI/RFI filters shall provide electric line noise attenuation from 10 kHz to 100 MHz.

2.2.6 EMI/RFI insertion loss shall exceed 50 dB using the MIL-STD-220A insertion loss test method at the maximum attenuation frequency.

2.2.7 The maximum continuous operating voltage (MCOV) of all components shall not be less than the following values

	MCOV (minimum)			
Nominal Voltage	L-L	L-N	L-G	N-G
208/120 Y, Solidly grounded 240/120 Solidly Grounded	300 V	150 V	300 V	150 V
600 Y, Solidly Grounded	840 V	420 V	420 V	420 V
600 Y, Resistance Grounded 600 D	750 V	n/a	750 V	n/a

2.2.8 SPDs for 208/120 and 240/120 V Solidly grounded systems shall have let-through voltage of less than the following:

	Let-through Voltage (V)			
Test	L-L	L-N	L-G	N-G
VPR (6 kV, 3 kA)	1000	600	700	700
C3 Impulse (20 kV, 10 kA)	1500	1000	1000	1000
A1 Ringwave (2 kV, 67 A)	50	50	400	400

2.2.9 SPDs for 600 V Solidly grounded systems shall have let-through voltage of less than the following:

	Let-through Voltage (V)			
Test	L-L	L-N	L-G	N-G
VPR (6 kV, 3 kA)	2500	1500	1500	1500
C3 Impulse (20 kV, 10 kA)	2500	1800	1800	1800

A1 Ringwave (2 kV, 67 A)	80	80	80	80

2.2.10 SPDs for 600 V resistance-grounded and delta systems shall have let-through voltage of less than the following:

	Let-through Voltage (V)	
Test	L-L	L-G
VPR (6 kV, 3 kA)	2500	2500
C3 Impulse (20 kV, 10 kA)	2500	2500
A1 Ringwave (2 kV, 67 A)	80	1100

2.2.11 Low Voltage Switchgear Protection

.1 The SPD shall be located within the switchgear and shall be connected to the bus through a breaker. The breaker and SPD shall be located within the switchgear in a common compartment.

.2 The SPD shall not require external fusing to achieve the short circuit ratings.

.3 All monitoring and diagnostic features shall be visible from the front of the equipment.

.4 Provide a transient event counter with LCD panel display and reset button on the front cover.

.5 Device characteristics shall be per contract drawings.

2.2.12 Motor Control Center Protection

.1 The SPD shall be located within the MCC and shall be connected to the bus through a breaker. The breaker and SPD shall be located within the switchgear in the same compartment.

.2 All monitoring and diagnostic features shall be visible from the front of the equipment.

.3 Provide a transient event counter with LCD panel display and reset button on the front cover.

.4 Device characteristics shall be per contract drawings.

2.2.13 600 V Distribution Panel Protection

.1 The SPD shall be located either within the panel or as physically close as possible and shall be connected to the bus through a breaker.

.2 All monitoring and diagnostic features shall be visible from the front of the equipment.

.3 Provide a transient event counter with LCD panel display and reset button on the front cover.

.4 Device characteristics shall be per contract drawings.

2.2.14 208-120 V Lighting/Power Panel Protection

.1 SPD shall be external to the panelboard (sidemount).

.2 Sidemount SPDs shall be feed from a breaker as close as possible to the main breaker or lugs. The contractor shall supply the appropriate breaker to meet the SPD manufacturer's requirements.

.3 Sidemount SPDs shall not exceed 105 mm x 105 mm x 300 mm (H) to minimum space requirements. For recessed panels, a flush mount cover plate shall be provided with each unit.

.4 SPDs mounted on subpanels feeding fire alarm panels shall have component level overcurrent fusing allowing for direct bus connection or installation on any size breaker or non-fused disconnect.

.5 Device characteristics shall be per contract drawings.

2.3 Control Voltage Circuits

2.3.1 The SPD for these locations shall be as indicated on project drawings.

2.3.2 The unit shall have an indicator light monitoring the status of the unit.

2.3.3 The unit shall have a peak surge current of no less than 70 kA/phase, 8 x 20 us waveform, single impulse.

2.3.4 SPDs installed in control voltage circuits do not require audible alarms.

2.3.5 The unit shall be mounted in line on a 120-volt circuit and must be capable of carrying a continuous 30 amp load.

2.4 Data & Signal Line Protection

2.4.1 The unit shall be listed under UL 497B, Standard for Isolated Loop Protector. The unit shall have a data transmission rate up to 10.0Mbps.

2.4.2 Each conductor shall have less than 4.7 ohm of internal series resistance per wire, and each pair of conductors shall have a peak surge current of no less than 9,000 amps per wire (18,000 amps per pair), 8 x 20 us waveform.

2.4.3 The maximum let-through voltage on an ANSI/IEEE C3 Impulse (20 kV/10 kA) shall be 41 volts line to line, 41 volts line to ground, and 41 volts shield to ground. The maximum let-

through voltage on an IEC 10 x 700 us impulse (2 kV/80A) shall be 38 volts line to line, 38 volts line to ground, and 38 volts shield to ground.

2.4.4 The response time of the components of the unit shall be less than one nanosecond.

2.4.5 SPDs installed in data and signal lines do not require audible alarms or form 'C' fault contacts.

2.5 Phone Line Protection

2.5.1 The unit shall be listed under UL 497A, Standard for Secondary Protectors for Communications Circuits.

2.5.2 The unit shall have a data transmission rate up to 16.0Mbps.

2.5.3 Each conductor shall have less than 1 ohm of internal series resistance per wire

2.5.4 Each pair of conductors shall have a peak surge current of no less than 2,000 amps, 8 x 20 us waveform.

2.5.5 The maximum let-through voltage on an IEC 10 x 700 us impulse (2 kV/80 A) shall be 240 volts tip-ring, 240 volts tip to ground, and 240 volts ring to ground.

2.5.6 The response time of the components of the unit shall be less than one nanosecond.

2.5.7 SPDs installed on phone lines do not require audible alarms or form 'C' fault contacts.

2.6 Acceptable Manufacturers

2.6.1 Total Protection Solutions (models are shown on the drawings, however, part numbers to be confirmed with the manufacturer and modified as recommended at no extra cost to the Owner).

2.6.2 Approved Equivalent

3 EXECUTION

3.1 Installation

3.1.1 Install the SPD's with the conductors as short and straight as practically possible.

3.1.2 Follow the SPD manufacturer's recommended installation practice as outlined in the equipment installation manual. The electrical contractor shall ensure that all neutral conductors are bonded to the system ground at the service entrance or the serving isolation transformer prior to installation of the associated SPD.

3.1.3 SPDs mounted within MCCs or distribution boards shall be installed in the factory by the manufacturer.

3.1.4 Main service entrance units shall be installed on a non-fused disconnect switch.

END OF SECTION