Invitation to Tender

CITY OF KENORA

INVITATION TO TENDER / ADVERTISEMENT

Sealed Tenders for: **Phase 1 WTP Pump Replacement and WWTP Electrical Upgrades.**
(the "Project")

Tender Number: 433-002-23

Will be received
by: Mail

City of Kenora
(the "City")

at:

1 Main Street South
Kenora, ON P9N 3X2
Attention: Heather Pihulak, City Clerk

by: Email;
Electronically submitted tenders can be directed to **hpihulak@kenora.ca.**

Time and date for Tender Closing is:

1:00:00 p.m. CST/CDT on **Thursday, October 16, 2025**
(the "Tender Closing")

1. The work to be undertaken generally involves, but is not necessarily limited to:
   - The replacement of one (1) high lift pump in the Water Treatment Plant and supporting electrical requirements; and
   - Electrical Upgrades to the Digester Building and Screw Pump Building at the Wastewater Treatment Plant.

2. The CITY's consultant for the Project is

   Ken Anderson, P.Eng.
   Manager, Water
   Associated Engineering (Sask.) Ltd.
   410-5 Donald Street
   Winnipeg, Manitoba. R3L 2T4
   Email: andersonk@ae.ca

3. The Successful Bidder shall achieve substantial performance of the Work for the Project by **July 31, 2026.**

4. The specifications for the Project can be obtained from **Daniel Mach, P.Eng.**, Project Manager, Capital Project Delivery | dmach@kenora.ca or from MERX.com within **City of Kenora Phase 1 WTP Pump Replacement and WWTP Electrical Upgrades.**

5. All written inquiries regarding the technical aspects of the drawings and specifications for the Work shall be sent to **Ken Anderson, P.Eng., via email at andersonk@ae.ca,**

however the bidder(s) acknowledge and agree that the CITY does not have an obligation to provide a response to any written inquiry and that it is in the sole and unfettered discretion of the CITY to provide any written response to a written inquiry. Telephone inquiries will not be replied to.

6. Submission of a tender by a Bidder gives the CITY the right to require the Bidder to execute the contract to perform the Work as set out within the tender documents. Tenders may not be withdrawn after the Tender Closing and will be irrevocable and open for acceptance by the CITY for a period of sixty (60) days following the end of the day of the Tender Closing. The Successful Bidder will be notified in writing of the award of the Tender when the CITY delivers a letter of intent to the Successful Bidder.

Phase 1 WTP Pump Replacement and WWTP Electrical Upgrades

Part 1: Phase 1 Water Treatment Plant Pump Replacement

Appendix “B-1” – Specifications

Appendix " C-1” - Drawings

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

CONTRACT DOCUMENTS

City of Kenora

Water Treatment Plant 2025 Pump Replacement

July 2025

CONTRACT SPECIFICATIONS
FOR
CITY OF KENORA
WATER TREATMENT PLANT 2025 PUMP REPLACEMENT

Kevin Yu, P.Eng.
Process Engineer

Scott Friel, P.Eng.
Electrical Engineer

Leon Zhang, P.Eng.
Structural Engineer

Prepared by Associated Engineering (Ont.) Ltd.

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1.1 THE WORK

.1 Description or title of the Work:

.1 City of Kenora Water Treatment Plant 2025 Pump Replacement.

.2 Located at:

.1 #5 Seventh St S, City of Kenora Water Treatment Plant

.3 Owner:

.1 City of Kenora

1.2 CONTRACT AGREEMENT

.1 The Agreement between the CITY, and the Contractor shall be the Standard Construction Document CCDC 2-2020, Stipulated Price Contract as approved by the Canadian Construction Documents Committee.

.2 Provide all necessary materials, labour, supervision and equipment, and perform all work and fulfill everything as set forth in strict accordance with the Contract Documents and Addenda.

END OF DOCUMENT

MODIFICATIONS TO GENERAL CONDITIONS

Supplementary Conditions to CCDC 2 – 2020 Stipulated Price Contract. The Contract is hereby revised as follows:

ARTICLE A-5 PAYMENT

Add 5.1.4 as follows:

.4 hold back 10%, or other percentage as required by the Lien Act, of any amounts net of value-added taxes due to the Contractor, if required by the Lien Act, such amounts will include amounts due for payment for Work performed after Substantial Performance of the Work"

DEFINITIONS

Definition "Owner", add the following:

"Owner shall mean **The City of Kenora**"

Add Definition

"Total Performance of the Work" means the Work, with the exception of Warranty Work, has been fully completed, including rectification of all known Deficiencies, and the Engineer has issued a certificate verifying that, in the opinion of the Engineer, Total Performance of the Work has been achieved.

GC 2.1 AUTHORITY OF THE CONSULTANT

Delete 2.1.1 and 2.1.2 and replace as follows:

2.1.1 The Engineer shall have authority to act on behalf of the Owner only to the extent provided for in this Contract or as the Owner may authorize, from time to time, but only to the extent that such authorization is communicated to the Contractor by Notice from the Owner.

2.1.2 The duties, responsibilities, and limitations of authority of the Engineer shall only be modified or extended by a Notice issued by the Owner to the Contractor.

GC 2.3 REVIEW AND INSPECTION OF THE WORK

Delete 2.3.2 and replace as follows:

2.3.2 If any portion of the Work is designated for tests, inspections or approvals in the Contract Documents, or by the Engineer, or by Law, the Contractor shall give the Engineer Notice of not less than 5 Business Days of when the Work will be ready for review and inspection. The Contractor shall arrange for, and shall give the Engineer reasonable Notice of, the date and time of inspections by all Governmental Authorities.

GC 2.4 DEFECTIVE WORK

Add 2.4.4 to 2.4.8 as follows:

1.4.4 At all times during the performance of the Work, the Contractor shall promptly remedy, correct and rectify any Deficiencies, whether or not the Deficiencies have been incorporated in the Work, and whether or not the Deficiencies are the result of poor workmanship, use of defective Materials, or vandalism, theft or damage through carelessness, negligence, inadequate security or

protection or other act or omission of the Contractor or any Person for whom the Contractor is responsible at Law.

1.4.5 The Contractor shall remedy, correct and rectify, as required to ensure the timely performance of the Work in accordance with the Construction Schedule, any and all:

(a) Deficiencies in a manner acceptable to the Engineer and the Owner; and

(b) Work, or other work, that is destroyed or damaged as a result of the Deficiencies or the remedying or correction thereof.

1.4.6 The Engineer may withhold from amounts due to the Contractor amounts on account of Deficiencies in accordance with GC 5.8 - WITHHOLDING OF PAYMENT AND SET OFF.

1.4.7 The Contractor is obligated to remedy, correct and rectify Deficiencies at its own cost and expense. The Contractor is not entitled to any payment under the Contract for any deficient Work or Materials that are incorporated into any Deficiency or that are otherwise in breach of the Contractor's obligations under this Contract. If the Owner or Engineer incur additional costs and expenses as a result of the Deficiencies including the Contractor's repairs or corrections of Deficiencies, the Contractor is liable to the Owner for such amounts and they may be withheld pursuant to GC 5.8 - WITHHOLDING OF PAYMENT AND SET OFF.

1.4.8 In the event that the Contractor does not remedy, correct or rectify the Deficiencies as required herein, the Owner may, upon expiry of 10 Business Days after giving Notice to the Contractor, take such steps as may be necessary to remedy, correct or rectify the Deficiencies in the Work or other work which is damaged or destroyed as a result of the Deficiencies or the remedying or correction thereof. In such event, the Contractor shall promptly pay the Owner for costs incurred by the Owner for remedying, correction or rectification of those Deficiencies, including both the Work or other work, if any, destroyed or damaged, or any alterations necessitated by the Contractor failing to remedy, correct or rectify the Deficiencies and any claims incurred by the Owner in so doing may be set-off against any monies due from the Owner to the Contractor.

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

Add 5.4.7 to 5.4.12 as follows:

5.4.7 When the Contractor considers that it has achieved Substantial Performance of the Work, the Contractor shall prepare and submit to the Engineer:

(a) a written application from the Contractor for a Certificate of Substantial Performance; and

(b) the Contractor's application for a Certificate of Substantial Performance shall constitute a waiver and release by the Contractor of any and all claims arising out of or relating to the Contract to the date of Substantial Performance. This waiver shall include without limitation those claims that might arise from the negligence or breach of contract by the Owner, the Engineer, and their respective employees, agents, officers, directors, and consultants, but does not include any claims made by the Contractor in writing prior to such application in accordance with the provisions of the Contract Documents and delivered to the Engineer prior to the date of Substantial Performance and still unsettled.

5.4.8 Failure to include an item on the comprehensive list of items described in paragraph 5.4.1 in GC 5.4 does not alter the responsibility of the Contractor to complete the Work or remedy, correct or rectify any Deficiencies.

5.4.9 If the Engineer determines that Substantial Performance of the Work has not been achieved, the Owner may deduct the cost of the inspection and assessment by the Engineer from payments otherwise due to the Contractor.

5.4.10 The Contractor may, after performing the required Work, re-apply for the Certificate of Substantial Performance, and the provisions of GC 5.4 shall apply to the re-application.

5.4.11 The Engineer shall include the date of Substantial Performance of the Work in the Certificate of Substantial Performance.

5.4.12 The Contractor shall promptly post a copy of the Certificate of Substantial Performance at a prominent and visible location at the Project Site.

GC 6.2 CHANGE ORDER

Add 6.2.3 to 6.2.5 as follows:

6.2.3 Costs for increase in the Contract Price, unless otherwise agreed, shall be marked up as follows:

.2 Materials supplied by the Contractor shall be paid for at Supplier's or subtrade's invoice price plus an additional payment of ten percent (10%) of cost to cover handling and indirect overhead costs.
.3 For subcontract Work, the allowance to the Contractor for profit, superintendence, and all other expenses shall be ten percent (10%) of the Subcontractor's invoice for such Work performed. No additional mark-up shall be allowed for subcontractors to subcontractors or beyond.
.4 Credits for decreases in the Contract Price may not be marked up.

6.2.4 The contractor must submit all details of quantities, prices and fees as outlined above, together with substantiating documentation.

6.2.5 A Change Order shall represent complete payment to the Contractor including for all impacts, related costs and expenses, including, without limitation time, labour, Materials, equipment, mobilization, Subcontractors, overhead, profit, insurance, bonding, and tools. The Contractor shall not be entitled to any additional change in Contract Time, Contract Price or any compensation for delay or other Claims arising from a duly executed Change Order.

GC 6.3 CHANGE DIRECTIVE

Delete 6.3.6.3 and replace as follows:

6.3.6.3 The Contractor's fee shall be as specified in paragraph 6.2.3 of GC 6.2.

GC 6.5 DELAYS
Add 6.5.6 to 6.5.9 as follows:

6.5.6 The Contractor acknowledges that if the Contractor fails to complete the Work within the Contract Time or fails to meet a specified Milestone Date for any part of the Work, the Owner will incur additional costs and expenses including additional administrative and overhead costs and will be required to pay additional compensation to the Engineer (collectively "Additional Expenses"). The Contractor agrees that in the event the Contractor fails to complete the Work

within the Contract Time or fails to meet a specified Milestone Date for any part of the Work, the Owner may deduct from any monies owing to the Contractor for the Work, as a genuine pre-estimate of the Owner's Additional Expenses, the amount specified under 6.5.9 of GC 6.5 for each Working Day the Work or any portion of the Work remains incomplete after the applicable Contract Time or Milestone Date. The Owner is not required to deduct such amounts from a current Payment Certificate but may instead deduct such amounts from a subsequent Payment Certificate or seek such amounts from the Contractor as a Claim.

6.5.7 The rights set out in paragraph 6.5.6 of GC 6.5 are in addition to any other rights the Owner may have and are in no way exclusive. The Contractor acknowledges that regardless of any amount specified in the Supplementary Conditions, the Owner may seek to recover from the Contractor its actual losses and damages suffered or incurred in respect of Additional Expenses, in addition to any other claim the Owner may have at Law.

6.5.8 No bonus will be allowed by the Owner for completion of the Work in less than the Contract Time.

6.5.9 The pre-estimate of the Owner's additional costs pursuant to paragraph 6.5.6 of GC 6.5 shall be $2,500 per Working Day.

GC 9.4 CONSTRUCTION SAFETY

Add 9.4.6 as follows:

9.4.6 The Contractor shall at all times comply with the provisions of all Law related to safety including the OH&S Legislation. The Contractor shall at all times ensure that all subcontractors at the Site shall comply with the requirements of all Law related to safety including the OH&S Legislation. The Contractor shall bring to the attention of all subcontractors the provisions of the OH&S Legislation.

GC 10.1 TAXES AND DUTIES

Delete paragraphs 10.1.1 to 10.1.2 and replace with the following:

10.1.1 The Contract Price includes all customs duties and taxes, except Goods and Services Tax (GST) or Harmonized Sales Tax (HST) or provincial sales taxes (PST), in effect at the time of the execution of this Contract.

10.1.2 The Contractor shall be responsible to pay all taxes.

10.1.3 The amount of GST, HST or PST payable by the Owner on goods and services provided under this Contract is in addition to the Contract Price and is to be shown on a separate line on Payment Certificates.

10.1.4 If the Owner is exempt from GST, HST or PST, a Certificate of Exemption will be issued to the Contractor following issuance of the Notice of Award.

10.1.5 The Contract Price shall include any tax rebates which may be applicable under current legislation. Upon request by the Contractor, the Owner shall provide certificates, in support of the Contractor's rebate submission to a Governmental Authority. The Owner shall not be liable to compensate the Contractor for any tax rebates that are denied by Governmental Authorities.

10.1.6 In the event that new or additional duties or taxes in respect of the Work are applicable or required by the Law after this Contract is executed, the Contract Price shall be adjusted to include such new or additional taxes and duties, if applicable.

GC 12.3 WARRANTY

Delete paragraphs 12.3.1 to 12.3.6 and replace with the following:

12.3.1 The Contractor warrants that the Work, including all workmanship, labour, Materials and equipment supplied by the Contractor, either directly or indirectly, and incorporated into the Work, shall comply in all respects with this Contract and shall be free from Deficiencies.

12.3.2 Subject to paragraphs 12.3.3 and 12.3.4 of GC 12.3, the Warranty Period with regard to the Work begins on the date of Total Performance and continues for a period of one year, except where a longer period is specified in the Contract Documents, then that period specified in the Contract Documents shall apply from the date specified in the Contract Documents or, if no date is specified, from the date of Total Performance of the Work.

12.3.3 Where Warranty Work is performed, regardless of the initial Warranty Period, the Warranty Period shall recommence for that Warranty Work for the same period as initially contemplated commencing on the date of completion of the Warranty Work.

12.3.4 The Contractor shall perform the Warranty Work, at the Contractor's expense, for all Deficiencies which appear during the Warranty Period for which the Contractor is provided Notice by the Owner or the Engineer no later than 30 Business Days after the end of the Warranty Period. The cost and expense of the Warranty Work for which the Contractor is responsible includes all costs and expenses incurred by the Owner and the Engineer in facilitating, administrating, or approving the Warranty Work.

12.3.5 The Contractor shall perform the Warranty Work promptly after Notice, provided that all Warranty Work carried out by the Contractor shall be performed during periods of time acceptable to the Owner.

12.3.6 In the event that the Contractor does not take steps to perform Warranty Work as required within a time period directed by or agreed upon by the Owner, the Owner may, upon expiry of 14 Business Days after giving Notice to the Contractor, take such steps as may be necessary to perform the Warranty Work. In such event, the Contractor shall promptly pay the Owner for costs incurred by the Owner the performance of the Warranty Work, including the cost to remedy any Deficiencies and to repair any other Work, if any, destroyed or damaged, or any alterations necessitated by the Contractor failing perform the Warranty Work.

12.3.7 The Contractor shall ensure that any Warranty Work which is of an emergency nature, as reasonably determined by the Owner, is performed immediately upon receipt of Notice from the Owner or the Engineer.

GC 13.1 INDEMNIFICATION

Delete paragraphs 13.1.1 to 13.1.5 and replace with the following:

13.1.1 The Contractor shall at all times and without limitation, be fully liable for, and shall indemnify and save harmless the Owner and its Personnel, including the Engineer, from and against all liabilities, losses, injuries, costs, damages, legal fees and disbursements on a solicitor and own client basis, disbursements, fines, penalties, expenses, all manner of actions, causes of action, claims, demands and proceedings, all of whatever nature and kind, which any of the Owner and its Personnel, including the Engineer, may sustain, pay or incur or which may be brought or made against all or any of them, and whether or not incurred, in connection with any action or other proceedings or claims or demands made by third parties, relating to, or resulting from or arising out of all or any of the following:

(a) the misconduct, negligent action or negligent failure to act, as the case may be, of the Contractor or any of those Persons for whom the Contractor is responsible at Law (including, without limitation, any of its Personnel or Subcontractors);

(b) the costs of repairs, clean-up or restoration paid by the Owner and any fines levied against the Owner or the Contractor;

(c) any breach, violation or non-performance of any representation, warranty, obligation, covenant, condition or agreement in this Contract set forth and contained on the part of the Contractor to be fulfilled, kept, observed or performed, as the case may be;

(d) any damages to third parties caused by, resulting at any time from, arising out of or in consequence of the misconduct, negligent action or failure to act of the Contractor or any of those Persons for whom the Contractor is responsible at Law (including, without limitation, any of its Personnel or Subcontractors);

(e) any damages, costs, fines, expenses and penalties that the Owner is required to pay on account of the Contractor performing the Work in breach of any Workers Compensation Legislation order or regulation; or

(f) any damages, costs, fines, expenses and penalties arising out of or as a result of the Contractor's failure, or the failure of any Person for whom the Contractor is responsible at Law, to comply with the requirements of GC 9.2 TOXIC OR HAZARDOUS SUBSTANCES.

13.1.2 The provisions in GC 13.1 are in addition to and shall not prejudice any other rights of the Owner at Law or in equity.

13.1.3 The Owner shall indemnify and hold harmless the Contractor and its Personnel from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the Contractor's performance of the Contract which are attributable to a lack of or defect in title to the Project Site.

13.1.4 If the Owner performs work at the Project Site at the same time as the Contractor is performing the Work, then the Owner shall indemnify and hold harmless the Contractor and its Personnel from and against claims, demands, losses, costs, damages, actions, suits or proceedings by third parties that arise out of or are attributable to, any act or omission or alleged act or omission of the Owner and its Personnel in the performance of that work.

13.1.5 If it becomes necessary for the Owner or its Personnel, including the Engineer, to take or to become involved in any action, including but not limited to legal proceedings, to enforce any term of this Contract, the Contractor shall be liable for and will pay to the Owner and its

Personnel, including the Engineer, all costs, including but not limited to legal fees and disbursements on a solicitor and own client basis, incurred by the Owner and its Personnel, including the Engineer, in relation to the action to enforce any term of this Contract.

ADDITIONAL GENERAL CONDITIONS

The following General Conditions are hereby added:

GC 5.8 WITHHOLDING OF PAYMENT AND SET OFF

5.8.1 Subject to paragraph 5.8.2 of GC 5.8, if for any reason there are any Deficiencies, including those that require Warranty Work, any portion of the Work that is not performed or there is any Claim by a third party made against the Owner arising from the Work, the Owner may withhold from payment to the Contractor such amounts as the Engineer determines are sufficient and reasonable to cover the cost of rectification, completion or resolution, until the Deficiencies are rectified, the Work is completed or such Claim is resolved.

5.8.2 The cost of rectifying Deficiencies or completing Work not performed shall be estimated by the Engineer and a value equivalent to twice that amount shall be withheld from any payment. Such holdback shall include any costs or expenses that the Engineer believes may be reasonably incurred by the Owner or Engineer as a result of the additional Work required to rectify the Deficiencies or to complete the Work not performed. Subject to any other right the Owner may have, the holdback amount shall be paid to the Contractor upon rectification of the Deficiencies or completion of the Work not performed, less:

(a) any actual additional costs or expenses incurred by the Owner or Engineer related to the Deficiencies and their rectification, after proper rectification of all the Deficiencies and completion of all Work; and

(b) any amount withheld pursuant to paragraph 5.8.1 of GC 5.8 for any Claim by third parties made against the Owner.

5.8.3 In preparing the estimate referred to in paragraph 5.8.2 of GC 5.8, the Engineer shall not be bound by the Contractor's unit prices and shall estimate the cost of rectifying Deficiencies or completing Work using their sole judgement of the influence of prevailing circumstances.

5.8.4 Notwithstanding any other provision of this Contract, the Owner shall be entitled to withhold and set-off against any monies otherwise due and payable to the Contractor under this Contract, any sums which the Owner is permitted to withhold either pursuant to this Contract or to any other agreement between the Owner and the Contractor, howsoever arising.

5.8.5 The Owner shall not pay interest on any amounts withheld from the Contractor under GC 5.8.

END OF DOCUMENT

Part 1 General

1.1 ORDER OF PRECEDENCE

.1 In the event of a conflict between the drawings and specifications, the contractor will endeavour to obtain clarification from the Engineer in an appropriate fashion prior to submitting their bid.

1.2 SUMMARY OF WORK

.1 The Contractor is responsible for reviewing all specifications and drawings together to determine the full extent of the contract scope and complexity. Work to be carried out under the Contract in general includes, but is not limited to the following:

- .1 Demolition of Process and Electrical Equipment as shown on plans. This generally includes one (1) High Lift Pump and its associated electric check valve.
- .2 Supply and installation of new process pump, electric check valve, control devices, process piping and ancillary equipment.
- .3 Supply and install new pump power and control panel, new VFD control panel, power cables to MCC and all related ancillary equipment.
- .4 Pump panel programming upgrades for distribution system and control logic. Includes new SCADA screen updates.
- .5 Conduct equipment start-up and commissioning.
- .6 All items as shown on the Contract Drawings and as detailed in these specifications.
- .7 Contract method: Standard Construction Document CCDC-2 2020 Stipulated Price Contract

.2 The Owner reserves the right to delete items from the tendered work, prior to contract award, if the tender prices exceed the project budget.

1.3 WORK BY OTHERS

.1 The scope of work identified will be undertaken as a single Contract.

1.4 WORK COMPLIANCE

.1 Provide all work conforming to the lines, levels and grades specified or shown on the Contract Drawings.

.2 Build all Works in a thoroughly substantial and workmanlike manner, in accordance with the Contract Drawings and Specifications, subject to such modifications and additions as may be deemed necessary during its execution. In no case will payment be made for any work in excess of the requirements of the Drawings and Specifications, unless approved in writing by the Engineer and the City.

1.5 ENGINEERING DESIGN

.1 Where specifications require work to be designed by an engineer, engage an engineering firm with a valid Certificate of Authorization with the Professional Engineers Ontario to design such work, and to stamp and sign any drawings and calculations forming part of

that design. The engineering firms must also provide proof of Errors and Omissions insurance as per the Special Provisions General Supplementary.

1.6 EXISTING SERVICES

.1 Owner will occupy plant during entire construction period for execution of normal operations of the plant.

.2 Coordinate construction works with the Owner in order to minimize conflict and to facilitate continual operation of the existing treatment plant until construction works are completed.

.3 The High Lift Pump to be replaced can be taken out of service for four (4) weeks, and may be extended if approved by the City. The remaining two pumps in service can provide sufficient redundancy.

.4 Where Work involves breaking into or connecting to existing services, give the Engineer 72 hours-notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance.

.1 Submit a schedule four weeks in advance of work to obtain approval from Engineer for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.2 A shutdown for a maximum of six (6) hours will be permitted for electrical tie-ins at the existing MCC and all work ancillary to this that may require a shut down. Shut down shall also be scheduled off peak demand periods and will be between the hours of 8pm and 6 am, unless approved otherwise by the City.

.3 Shutdowns must not take place during peak times. Refer to Hours of Work for schedule constraints.

.4 The Contractor and their trades will be required to develop a Work Plan to the satisfaction of the Owner for major work that disrupts the supply and service of water in and out of the plant.

.1 The Work Plan must be finalized within 48 hours of said work.

.5 Provide temporary services as required to maintain critical systems.

.6 Where unknown services are encountered, immediately advise Engineer and confirm findings in writing.

.7 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

.8 Record locations of maintained, re-routed and abandoned service lines.

.9 Maintain fire access/control.

1.7 SELECTIVE DEMOLITION

.1 Note that the existing HLP-1 and motor along with electric check valve can remain in pump area for Owner to use as emergency spares. Coordinate storage location with engineer and owner. Equipment would be stored under monorail at far east end.

.2 As noted on drawings, the inside of MCC-2 bucket will be emptied of abandoned relays and equipment once control and power is switched over to new.

1.8 CONTRACT DRAWINGS

.1 For easy reference, the Contract Drawings have been divided into disciplines. However, all Drawings shall be read in conjunction with one another, since details applicable to one discipline may appear on the Drawings of another discipline.

.2 Additional drawings may be supplied from time to time by the Engineer during the construction of the Works for information and/or clarification to assist the Contractor, and will not become a basis for extra payment. Drawings covering additional work may be supplied by the Engineer during performance of the Contract, and that work may qualify for additional payment.

.3 Contract Drawings give general location of existing facilities/utilities. The Contractor shall confirm the location of the existing facilities/utilities, and identify any interferences. Where interferences are identified, the Contractor shall propose a possible solution addressing the interference to the satisfaction of the Engineer.

.4 Assume dimensions shown on contract drawings are correct ±50 mm for bidding purposes. Contractor / vendor must field measure during shop drawing preparation prior to first submittals to confirm all dimensions.

1.9 SITE EXAMINATION

.1 Before submitting their Tender, the Contractor shall examine the job site, soil conditions, construction, and waste and storage areas; compare plans and specifications with existing conditions; and fully satisfy themselves as to all data and matters required for the completion of the contract.

.2 Failure to acquaint themselves fully with all available information concerning conditions affecting the Work shall not relieve the Contractor of the responsibility for estimating the difficulties and costs of satisfactorily performing the Work.

1.10 PERMITS LICENSES, REGULATIONS & ACTS

.1 The Contractor shall be responsible for obtaining and paying, for any and all permits or licenses as may be required for any portion of this contract. The Contractor shall comply with all Municipal and Provincial Government regulations as they apply to the work of this contract.

1.11 DRAWINGS AND SPECIFICATIONS FURNISHED

.1 Owner Responsibilities:

.1 Provide PDF copy of project specifications and drawings to Contractor. Printed copies will NOT be provided.

.2 Contractor Responsibilities:

.1 Print copies of drawings and specifications as required.

.2 Maintain at Site, one complete set of drawings and specifications. Make available to Engineer at any time.

1.12 DETAILED WORK SCHEDULE

.1 In addition to General Conditions, the Contractor shall provide the Owner with a detailed work schedule in the form of a Gantt Chart. The schedule shall include the following activities as a minimum:

.1 Mobilization;

.2 Tie-ins to existing services;

.3 Commissioning; and,

.4 Site cleanup, restoration and demobilization.

.2 Contractor shall identify critical path items and long lead items, and order all long lead equipment, such as vortex removal equipment, as soon as receiving order to commence work. Contractor shall provide a schedule detailing long lead equipment delivery times.

.3 **Submit finalized detailed construction schedule with major milestones within 30 days of Notice of Award.**

1.13 HOURS OF WORK

.1 The Contractor must comply with local by-laws and regulations (i.e. noise, etc.).

.2 Extended hours of operation may be allowed upon written request by the Contractor for review and approval by the City.

.1 All shut downs as described in Existing Services must be performed between the hours of 7:30 pm to 5:30 am.

1.14 CONTRACTOR USE OF PREMISES

.1 Ascertain boundaries of Site within which work must be confined.

.2 Provide approved security fencing around the work and storage areas in accordance with the Occupational Health and Safety Act.

.3 As provided in the Occupational Health and Safety Act, the Contractor must assume responsibility for all personnel on site. The Engineer may authorize others to have access to the site as necessary.

.4 Ascertain and abide by conditions pertaining to use of easements or rights-of-way.

.5 Assume full responsibility for protection and safekeeping of products/equipment under this Contract.

.6 Obtain and pay for use of additional storage, access or work areas needed for operations under this Contract. All storage areas must be approved by the Engineer prior to use. Materials must be stored so as to ensure the preservation of their quality and fitness for use.

.7 Protect all newly constructed work from damage of any form. Any portion of the work, which is damaged, must be rebuilt at the Contractor's expense to the satisfaction of the Engineer.

.8 The Contractor will be responsible for providing washrooms and temporary power for use by the Contractor and the Engineer.

.9 No smoking will be permitted at the plant or any other City facility.

1.15 ADDITIONAL DEFINITION

.1 In addition to Title of Contract Administrator, Titles Engineer and/or Consultant as state in various sections of the Specifications, means the person, partnership, or corporation designated by the Owner to be the Owner's Representative for the purpose of the Contract.

1.16 SUPPLEMENTARY DRAWINGS

.1 Engineer may furnish supplementary drawings to assist proper execution of work. Such drawings will be issued for clarification only and will have same meaning and intent as if included with plans referred to in Contract Documents.

1.17 SUBSTITUTIONS

.1 The Contract Price is based upon those materials and equipment models identified and named in the detailed Specifications. Substitutions or variations to those specified will not be allowed without formal submittal, review and acceptance in accordance with this section.

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

.3 Coordinate pertinent related work and modify surrounding work as required to complete project under each substitute designated.

.4 This section does not refer to alternative methods of construction but specified materials and equipment.

1.18 REQUESTS FOR SUBSTITUTION

.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.

.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.

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

.4 Request for substitution to be made by written application to the Engineer and 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 necessitate 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.

.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 Completion.

.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.

.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.

.5 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.

1.19 PROJECT MEETINGS

.1 The Engineer and Owner will administer preconstruction meeting and progress meetings to be held at intervals as determined by the Engineer.

.2 Contractor's superintendent and senior representatives of major Subcontractors are to attend all meetings.

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

.3 Where required, the Contractor shall provide physical space for the meetings.

.4 Preconstruction Meeting:

.1 Within 21 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Senior representatives of the Owner, Engineer, Contractor, and major Subcontractors will be in attendance.

1.20 SCAFFOLDING

.1 Scaffolding in accordance with CAN/CSA-S269.2.

1.21 HOISTING

.1 Hoists and cranes to be operated by qualified operator.

1.22 MATERIALS TO BE SALVAGED

.1 Remove, clean, deliver, unload and neatly stockpile at site materials which are specified or designated by Engineer to be salvaged.

.2 Repair or replace at Contractor's expense salvaged materials damaged during removal, unloading or in transit.

.3 Provide Owner first right of refusal.

1.23 EXISTING CONDITIONS

.1 Buried services:

.1 Before commencing work verify location of buried services on and adjacent to site.

.2 Confirm locations of buried utilities by careful test excavations.

.3 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.

.4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.5 Maintain and protect from damage, water, sewer, gas, electric, telephone, and other utilities and structures encountered.

.6 Where utility lines or structures exist in area of excavation, obtain direction of Engineer before removing or re-routing.

.7 Record location of maintained, re-routed, and abandoned underground lines.

.8 Confirm locations of recent excavations adjacent to area of excavation.

.9 Prior to beginning excavation Work, notify Consultant and authorities having jurisdiction establish location and state of use of buried utilities and structures.

.2 Existing buildings and surface features:

.1 Conduct, with Engineer, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey benchmarks, and monuments which may be affected by Work.

.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair to approval of Engineer.

.3 Where required for excavation, cut roots or branches as approved by Engineer.

1.24 JOB SITE DOCUMENTS

.1 Maintain at job site, one copy each document as follows:

.1 Contract Drawings
.2 Specifications
.3 Addenda
.4 Reviewed Shop Drawings
.5 List of Outstanding Shop Drawings
.6 Change Orders
.7 Other Modifications to Contract
.8 Field Test Reports
.9 Copy of Approved Work Schedule
.10 Health and Safety Plan and Other Safety Related Documents
.11 Other documents as specified

1.25 SANITARY FACILITIES

.1 The Contractor shall provide sanitary facilities for the workers on the project.

1.26 SITE CONTAINMENT AND PROTECTION

.1 Install the construction fencing around all work areas. Maintain access for public and private residences and properties.

.2 Contractor shall develop a plan that outlines the measures they will implement to contain the site and protect the public. Plan shall be submitted to, discussed with, and approved by the Owner and Engineer prior to mobilization.

.3 At a minimum plan shall include placement of fencing around the work sites, equipment and material staging areas, etc.

.4 Provisions should be provided to allow pedestrian traffic around the work site, while still providing adequate protection and space for the work to be performed.

.5 Contractor may need to assess Site Containment and Protection as the Work progresses and adjust fencing and protection measures based on actual flow of pedestrians and work progress.

.6 Contractor shall maintain protection measures throughout the duration of the project and shall immediately address concerns raised by the Owner or Engineer.

.7 Construct temporary barriers around trees designated to remain prior to construction as directed by the Engineer.

.8 Replace any trees designated to remain, if damaged, as directed by the Engineer or as indicated on Contract Drawings, at no additional cost to the Owner.

1.27 CHECKING OF DIMENSIONS

.1 Carefully check dimensions of structures shown on the Drawings before commencing work thereon. Notify the Engineer of any errors or discrepancies.

.2 Where equipment is to connect to existing, preliminary dimensions have been shown on the Drawings. These dimensions have not been taken from final Shop Drawings. Contractor to confirm all dimensions.

1.28 QUALITY CONTROL

.1 Inspection

.1 Owner and Engineer shall have access to Work.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Engineer instructions, or law of Place of Work.

.3 If 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.

.2 Independent Inspection Agencies

.1 If required, independent inspection/testing agencies will be engaged by Engineer for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Owner.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Reports

.1 Submit 1 copy of mix designs and inspection and test reports promptly to Engineer.

.2 Provide copies to Subcontractor of work being inspected/tested.

1.29 PROJECT CLOSEOUT

.1 Final Cleaning

.1 When the Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste materials and debris from site at regularly scheduled times or dispose of as directed by Engineer. Do not burn waste materials on site, unless approved by Engineer.

.2 Systems Demonstration

.1 Prior to final inspection, demonstrate operation of each system to Owner and Engineer.

.2 Instruct personnel in operation, adjustment, and maintenance of equipment and systems, using provided operation and maintenance data as basis for instruction.

.3 Documents

.1 Collect reviewed submittals and assemble documents executed by Subcontractors, suppliers, and manufacturers.

.2 Submit material prior to final Application for Payment.

.3 Submit operation and maintenance data, record drawings.

.4 Execute transition of Performance and Labour and Materials Payment Bonds to warranty period requirements.

.5 Submit a final statement of accounting giving total adjusted Contract Amount, previous payments, and monies remaining due.

.6 Engineer will issue a final change order reflecting approved adjustments to Contract Amount not previously made.

.4 Inspection/Takeover Procedures

.1 Prior to application for Certificate of Total Performance, carefully inspect the Work and ensure it is complete, that all construction deficiencies are complete, defects are corrected, and building is clean and in condition for occupancy. Notify Engineer, in writing, of completion of the Work and request an inspection.

.2 During Engineer inspection, a list of deficiencies and defects will be tabulated. Correct same.

.3 Make application for Certificate of Total Performance.

Part 2 Products

2.1 CAST-IN-PLACE CONCRETE

.1 Concrete work shall conform to CSA A23.1

.2 All Concrete to be supplied by a Ready Mix Facility that is certified by Concrete Ontario.

.1 Submit proposed Mix Design and Certification to engineer and approved testing firm two weeks prior to commencement of work.

.2 Submit with mix design:

.1 Copy of certificate showing the valid member of Concrete Ontario.

.2 Copy of Test Results by an independent testing company for all materials used in the proposed mix showing that they comply with the CSA A23.1/A23.2 requirements.

.3 Provide documentation showing that proposed mix design will achieve the required strength, durability, and performance requirements.

.3 Concrete Type

.1 Pump Pad:

.1 Exposure Class N

.2 Type HS

.3 35 MPa at 56 Days

.4 Natural Air

.5 Superplasticizer is not required.

.4 Temperature: Concrete when placed to at least 10ºC but not above 30ºC.

.5 Mix design to minimize shrinkage and to maximize water tightness.

.6 Mix proportions shall produce a mixture which will work readily into corners and angles of forms and around reinforcement. Mix proportions shall not permit segregation and shall not cause excessive water to collect on the surface.

.7 The addition of water to concrete at the site will not be permitted.

.8 Contractor should place all component to be embedded in the concrete (weld plates, dowels for concrete and or masonry, anchor bolts, inserts, water stop bars, sleeving etc.) See Mechanical and Electrical and all drawings for inserts/penetrations.

.9 Finishes

.1 Provide steel hard troweled, smooth finish

2.2 CAST-IN-PLACE REINFORCEMENT

.1 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.

.2 Shop Drawings:

.1 Indicate placing of reinforcement and:
.2 Bar bending details.
.3 Lists.
.4 Quantities of reinforcement.
.5 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
.6 Indicate sizes, spacings and locations of chairs, spacers and hangers.
.7 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.
.1 Provide type B tension lap splices unless otherwise indicated.
.8 When Chromate solution is used as replacement for galvanizing non-prestressed reinforcement, provide product description for review by Engineer prior to its use.

.3 Reinforcing steel: billet steel, grade 400R, deformed bars to CSA-G30.18, unless indicated otherwise.

.4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.

.5 Chairs, bolsters: to CSA-A23.1/A23.2. All supports to be plastic or epoxy coated. Indicate support types and materials on shop drawings.

2.3 FORM WORK

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, CSA O437 Series, CSA-O153.

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 MEASUREMENT FOR PAYMENT

.1 For lump sum price item, Engineer will calculate payment based on tendered price and Engineer's estimate of percentage of work item completed.

.2 For each unit price item, Engineer will calculate payment based on tendered unit price and Engineer's determination of units of work item completed.

.3 Where a method of measurement for payment for a work item is not specified, payment for that item will be deemed to be included in another pay item or other pay items.

1.2 PROGRESS PAYMENTS

.1 Refer to CCDC 2 Part 5 Payment.

1.3 CHANGES

.1 Refer to CCDC 2 Part 6 Changes in Work.

1.4 PAYMENT ITEMS

.1 GENERAL REQUIREMENTS

.1 METHOD OF MEASUREMENT: for GENERAL REQUIREMENTS shall be based on 50% of the lump sum price paid upon completion of mobilization and the remaining 50% equally divided by the duration of construction (in months) and that amount paid monthly.

.2 BASIS OF PAYMENT: Payment for GENERAL REQUIREMENTS shall be paid for at the Contract Lump Sum Price shown in the Bid Form.

.1 Lump sum price shall not exceed 10% of the total bid.

.2 Price includes labour, equipment and materials, and work incidental to permits; insurance, bonding, mobilization; demobilization; and other work required for setting up the Work.

.2 PROCESS MECHANICAL WORKS

.1 METHOD OF MEASUREMENT: “PROCESS MECHANICAL WORKS” shall be based on the percentage (%) complete of the Contract Lump Sum Price.

.2 BASIS OF PAYMENT: Payment for “PROCESS MECHANICAL WORKS” shall include work related to supply, construction, installation, and testing of all process systems, equipment, controls and associated works. Includes process piping and appurtenances, piping supports, pump bases, pumps, removal of existing process pump and ancillary equipment, removal of existing pump base and all other removals identified on the drawings and identified in the specifications. All other related material and work shall be considered incidental thereto.

.3 ELECTRICAL AND INSTRUMENTATION WORKS

.1 METHOD OF MEASUREMENT: "ELECTRICAL AND INSTRUMENTATION WORKS" shall be based on the percentage (%) complete of the Contract Lump Sum Price.

.2 BASIS OF PAYMENT: Payment for "ELECTRICAL AND INSTRUMENTATION WORKS" shall include work related to the supply, installation, commissioning of the new Pump Control Panel, VFD Panel, including interconnections to equipment and the existing MCC, and any required housekeeping pads and all work ancillary to the VFD panel. Includes also all instrumentation, controls and programming and the selective demolition and removals as noted in the plans. All other related material and work shall be considered incidental thereto.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Construction schedule

.2 Shop drawings and product data

.3 Samples

.4 Operating and maintenance manuals

.5 Record drawings

.6 Warranty Certificates

1.2 ADMINISTRATIVE

.1 Provide to Engineer for review the submittals specified. Submit with reasonable promptness and in an orderly sequence so as to not cause delay in the Work. 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.

.2 All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be shown on all submissions for Engineer review.

.3 At Engineer's request, prepare and submit schedule fixing the dates for submission and return of shop drawings, product data or samples.

.4 Do not proceed with Work affected by the submittal until review is complete.

.5 Review submittals prior to submission to Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project will be returned without being examined and shall be considered rejected.

.6 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents and stating reasons for deviation.

.7 Verify that field measurements and affected adjacent Work are coordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer review.

.10 Keep one reviewed copy of each submission on Site.

1.3 CONSTRUCTION SCHEDULE / WORK PLAN

.1 Refer to Specifications.

1.4 WORK PLANS

.1 Provide Work Plans for each key activity, as requested by Engineer, to show construction methods. Relate Work Plan to activities shown on Construction Schedule.

1.5 SHOP DRAWINGS AND PRODUCT DATA

.1 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, wiring diagrams, panel layouts with bills of material, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.2 Adjustments made on shop drawings by Engineer are not intended to change the Contract Amount. If adjustments affect the value of Work, state such in writing to Engineer prior to proceeding with Work.

.3 Make such changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of any revisions other than those requested.

.4 Submissions shall include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

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

.5 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 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

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

.1 "REVIEWED" - Make and distribute additional copies as required for execution of Work.

.2 “REVIEWED AS NOTED” – This notation indicates when Engineer has provided notations on the shop drawings that must be incorporated into the goods or work. Make and distribute additional copies as required for execution of the work.

.3 "REVISE & RESUBMIT" - Make the necessary revisions and resubmit revised drawings for review. Show the drawing number of the first such revised drawing and show the latest revision number applicable to the drawing by adding a suffix to the drawing number as - "REV. 1", "REV. 2", etc.

.4 "NOT REVIEWED" - This notation indicates when Engineer has not reviewed the drawing. It may also be used in combination with the notation to revise and resubmit the drawing where Engineer lacks sufficient information to complete the review and requires resubmitting the drawing for review after revision.

.5 Drawings will be marked "REVIEWED" together with the notation to "REVISE & RESUBMIT" when Engineer requires Contractor to resubmit a revised drawing showing corrections made as a result of Engineer's notations on the shop drawings. This procedure will not relieve Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of Contract.

.6 Use only those shop drawings on the work that bear the "REVIEWED" notation.

.7 Do not revise shop drawings marked "REVIEWED" unless resubmitted to Engineer for further review.

.8 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 shall be submitted together, to enable Engineer to review the drawings as a package.

.9 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.

.10 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.

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

.12 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 or Territory where the work is located, 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.

.13 Owner may deduct, from payments due to Contractor, costs of additional engineering work incurred if correct shop drawings are not submitted after one review by Engineer.

.14 Review by Engineer is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Engineer approves the detail design

inherent in the shop drawings, responsibility for which remains with Contractor, and such review does not relieve Contractor of the responsibility for errors or omissions in the shop drawings or of the responsibility for meeting all requirements of the Contract Documents. 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.

.15 Shop drawings for the following structural components shall bear the seal of a registered engineer of Ontario:

.1 Shoring

.2 Structural steel/aluminum

.3 Structural connection details

.4 Concrete formwork and falsework as required by Engineer.

.5 Pre-Engineered Building Components.

.16 Samples

.1 Submit for review, as requested in respective specification Sections.

.2 Deliver samples prepaid to Engineer's business address.

1.6 OPERATIONS AND MAINTENANCE MANUALS

.1 Submit Operating and Maintenance Manuals to Engineer, per Specification Section.

1.7 RECORD DRAWINGS

.1 After award of Contract, Engineer will provide a set of drawings for the purpose of maintaining record drawings. During progress of the work, accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by Engineer.

.2 Record locations of concealed components of mechanical and electrical services.

.3 Record following information:

.1 Significant deviations from the contract documents caused by site conditions and changes ordered by the Engineer.

.2 Horizontal and vertical location of piping, underground utilities and appurtenances referenced to permanent surface improvement.

.3 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

.4 Location and elevation of all crossed utilities during piping installation.

.5 Field changes of dimension and detail.

.6 Depths of various elements of foundation in relation to finished floor.

.7 Changes made by Change Order or field direction.

.8 Location of all installed equipment and electrical.

.4 Contractor shall provide complete record drawings of all Electrical and Instrumentation and Control Drawings. Drawings shall include all modifications made by addenda, change orders, site instructions, RFC’s, RFI’s, etc.

.5 Identify drawings as "Project Record Copy". Maintain in good condition, keep continuously updated and make available for inspection on site by Engineer.

.6 On completion of Work and prior to final inspection, submit record documents to Engineer.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section outlines the Contractor's responsibilities for environmental requirements for this Work.

.2 The environmental controls shall be in accordance with the Owner's General Conditions and as amended or extended herein.

.3 Furnish all labour, materials, and equipment necessary to install and maintain environmental protection systems.

1.2 CONSTRUCTION CLEANING

.1 Maintain the Work in tidy condition, free from the accumulation of waste products and debris, other than that caused by Owner or other contractors.

.2 Remove waste material and debris from the site at the end of each day that work takes place.

.3 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

.4 Promptly clean up any spillage that occurs on site roads, access roads or public roads, or other areas where construction vehicles are travelling.

.5 If Contractor is negligent in maintaining cleanliness of roads, Owner will arrange for cleaning to be done at Contractor's expense.

1.3 DISPOSAL

.1 Do not bury rubbish and waste materials on site unless approved, in advance, by Engineer.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into lagoon, waterways, storm or sanitary sewers.

.3 Remove from Site wastes and materials specified or designated by Engineer to be disposed of. Dispose of these wastes and materials at sites provided by Contractor.

1.4 FIRES

.1 Fires and burning of rubbish on site not permitted.

Part 2 Products

.1 Not Used

Part 3 Execution

3.1 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under the Contract.

.2 Control emissions from equipment and plant to requirements of authorities having jurisdiction.

.3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

.4 Establish suitable fueling and maintenance areas and review with the Engineer.

.5 Do not refuel or maintain equipment adjacent to or in watercourses.

.6 Do not fuel equipment within thirty (30) metres of any water course unless non-spill facilities are used.

.7 Submit procedures for interception, rapid clean up and disposal of spillages that may occur, for Engineer's review, prior to commencing Work.

.8 Be prepared at all times to intercept, clean up and dispose of any spillage that may occur whether on land or water.

.9 Keep all materials required for clean up of spillages readily accessible on site.

.10 Report immediately any spills causing damage to the environment to Spills Action Centre of the Ministry of the Environment.

.11 Do not empty fuel, lubricants or pesticides into sewers or watercourses.

.12 Dispose of all construction debris in an approved location.

.13 Clean construction equipment prior to entering public roadways to prevent litter or mud from being deposited on to the roads

3.2 SPILLS REPORTING

.1 Be responsible for the adverse effects of a spill including all costs associated with clean-up and remediation of any contaminants. The discharger is expected to contain and clean up the spilled contaminant or arrange for the contaminant to be contained and cleaned up. The discharger is also expected to restore the spill site to pre-spill conditions where this can reasonably be expected. To achieve this, the discharger may have to remove the contaminated soil and debris and dispose of these materials in accordance with the applicable environmental legislation at an approved disposal site.

.2 Prior to commencing construction, the Contractor is to prepare and submit for approval, a contingency plan for the control and clean up of a spill. This plan must adhere to the requirements and regulations of he WHMIS (Work Hazardous Material Information System) and shall include the applicable MSDS (Material Safety Data Sheet) for each substance.

.3 In the event of a spill or other emission of a pollutant into the natural environment, every person responsible for the emission or who causes or permits it must forthwith notify:

.1 The Ministry of the Environment Spills Action Centre (SAC)

.2 The owner of the pollutant, if known;

.3 The person having control of the pollutant, if known; and

.4 The Owner and the Engineer, including the nature of the spill, of the circumstances thereof, and of the action taken or intended to be taken with respect thereto.

3.3 NOISE CONTROL

.1 The Contractor shall establish and maintain site procedures such that noise levels from construction areas are minimized.

.2 Use vehicles and equipment equipped with efficient muffling devices.

.3 Provide and use noise attenuation devices (barriers) that will minimize noise level in construction area.

.4 Comply with noise bylaws.

3.4 DUST CONTROL

.1 Prevent dust nuisance resulting from construction operations at all locations on site.

.2 Use water, brine or calcium chloride to control dust.

.3 Minimize use of calcium or brine, particularly in close proximity to sewers, wastewater treatment facility, watercourse or agricultural lands.

.4 Transport dusty materials in covered haulage vehicles.

.5 Public roadways shall be kept clean and free of mud.

.6 Dust control shall be at the Contractor’s expense and to the satisfaction of the Engineer.

3.5 CONTINGENCY PLAN

.1 Prior to commencing construction, prepare a contingency plan for the control and clean up of a spill. The contingency plan to include:

.1 The names and the telephone numbers of the persons in the local municipalities to be notified forthwith of a spill.

.2 The names and the telephone numbers of the representatives of the fire, the police and the health departments of the local municipalities who are responsible to respond to emergency situations.

.3 The names and the telephone numbers of the companies experienced in the control and clean up of hazardous material that would be called upon in an emergency involving a spill.

.4 The Contractor's proposal for the immediate containment and control of the spill, the clean-up procedures to be initiated immediately and any other action to be taken to mitigate the potential environmental damage while awaiting additional assistance.

.5 The name and the telephone number to the Contractor's representative responsible for preparing, implementing, directing and supervising the contingency plan.

.2 The Contractor shall ensure the immediate availability of the products with which to effect temporary repair to broken pipelines and other services so the spill or other emission of a pollutant is immediately controlled and stopped and to mitigate the damages.

.3 Submit for the Engineer's review, a copy of the Contingency Plan and make appropriate changes to it based upon the feedback received.

3.6 RE-INSTATEMENT

.1 Where directed by Engineer, Contractor to make good all damages caused to the site to the satisfaction of the Engineer.

END OF SECTION

Part 1 General

1.1 REQUIREMENTS INCLUDED

.1 Regulations affecting the Work imposed by:

.1 Fisheries and Oceans Canada.

.2 Environment Canada.

.3 Ontario Building Code

.4 Occupational Health and Safety Act

.5 Ontario Fire Code

.6 Municipal by-laws and servicing standards

.7 Municipal utilities

.8 Ontario Electrical Safety Code.

.9 Design Reference Standards as captured within the individual specification sections.

1.2 COMPLIANCE WITH REGULATIONS

.1 Ascertain requirements and regulations of authorities listed above.

.2 Comply with all such requirements and regulations as applicable to the Work.

.3 Requirements set out in this Section are for guidance and information and are not necessarily complete.

1.3 CODES AND STANDARDS

.1 The Contractor shall:

.1 Perform Work in accordance with the latest named published editions of codes and standards.

.2 Provide materials and workmanship, which meet or exceed the specifically named code or standard.

.3 Execute Work in accordance with the applicable Federal, Provincial, Territorial, Municipal, and town 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 standards and practices.

.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 shall 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 the Construction Health and Safety Branch of the Ministry of Labour with the information required under Section 4 of the Ontario Regulation 691/80 prior to commencing Work.

1.4 PERMITS

.1 The Contractor shall be responsible for obtaining and paying, for any and all permits or licenses as may be required for any portion of this contract. The Contractor shall comply with all Municipal and Provincial Government regulations as they apply to the work of this contract.

.2 The Owner will secure the approval from the Ontario Ministry of Environment as required.

1.5 WORK IN VICINITY OF OVERHEAD POWER LINES

.1 Contractor to confirm the following setback requirements for operation near power lines with local utility.

.2 Request power company to relocate, de-energize or guard any energized conductor where construction equipment may operate within 3 m of conductor.

.3 Obtain power company approval prior to operating any equipment within 3 m of energized conductor.

.4 Where practical, avoid storage of metallic pipe sections under high voltage overhead power lines.

.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.

.6 Complete and submit applicable Workplace Safety and Insurance Board (WSIB) Forms prior to commencement of Work.

1.6 PERFORMING HOT WORK

.1 Hot work to be carried out under the Contract includes, but is not limited to:

.1 Performing welding, cutting, grinding, braising or soldering work:

.1 In Class 1, Zone 1 locations

.2 In confined spaces which contain or may contain an explosive or flammable hazard.

.3 In or on equipment designated by the Owner as being potentially hazardous due to the possible presence of flammable gases, dust or vapours.

.4 In Hazardous room.

.5 Outside of designated areas.

.2 The contractor shall execute work in accordance with The Hot Work Policy from The Owner.

Part 2 Products

.1 Not Used.

Part 3 Execution

.1 Not Used.

END OF SECTION

Part 1 General

1.1 QUALITY

.1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.

.3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.4 Should disputes arise as to quality or fitness of products, decision rests strictly with the Engineer based upon requirements of Contract Documents.

.5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.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.

1.2 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify the Engineer of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In event of failure to notify the Engineer at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Engineer reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.3 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.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 required in Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.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.

.6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to satisfaction of the Engineer.

.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.

1.4 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

.2 Transportation cost of products supplied by Owner will be paid for by Owner. Unload, handle and store such products.

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, 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.

.2 Notify the Engineer in writing, of conflicts between specifications and manufacturer's instructions, so that the Engineer will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Engineer to require removal and re-installation at no increase in Contract Price or Contract Time.

1.6 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the Engineer if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. the Engineer reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with the Engineer, whose decision is final.

1.7 CO-ORDINATION

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.8 CONCEALMENT

.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation inform the Engineer if there is interference. Install as directed by the Engineer.

1.9 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.10 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform the Engineer of conflicting installation. Install as directed.

1.11 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.12 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for all interior and exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.13 QUANTITIES

.1 Schedules of piping, fittings, reinforcing, or other materials indicating quantity and/or dimension, which are shown on the drawings or in the specifications, are intended only to assist Contractor with quantity takeoff. Quantities and dimensions shown therein are not guaranteed to be accurate and must be checked by Contractor prior to placing an order for such materials.

.2 Claims for additional payment resulting from variations between quantities shown on the schedules and those actually installed will not be accepted.

1.14 OWNERSHIP

.1 All materials provided by Contractor for execution of Work will vest in and become the property of Owner upon delivery to Site, but will remain in the custody and at the risk of Contractor until Final Completion.

1.15 PROTECTION OF WORK IN PROGRESS

.1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of the Engineer.

1.16 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.17 PLANT EQUIPMENT COMPATIBILITY

.1 All materials and equipment shall be suitable for installation in a water plant environment. (i.e. temperature, humidity, moist environment, submerged, etc.). Any and all problems incurred due to environmental factors shall be remedied by the contractor. No warranty provisions shall be voided due to plant environment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 The Contractor, for purposes of the Ontario Occupational Health and Safety Act, shall be designated as the Constructor for this project and shall assume all of the responsibilities of the Constructor as set out in that Act and its regulations. The foregoing shall apply notwithstanding that the successful bidder has been referred to as the 'Contractor' in this and any other related document. The Contractor shall comply with the following:

.1 The Contractor acknowledges that the Contractor has read and understood the Occupational Health and Safety Act (R.S.O. 1990, C-0.1, as amended).

.2 The Contractor covenants and agrees to observe strictly and faithfully the provisions of the said Occupational Health and Safety Act and all regulations and rules promulgated thereunder.

.3 The Contractor agrees to indemnify and save the Owner harmless for damages or fines arising from any breach or breaches of the said Occupational Health and Safety Act.

.4 The Contractor agrees to assume full responsibility for the enforcement of the said Occupational Health and Safety Act to ensure compliance therewith.

.5 The Contractor further acknowledges and agrees that any breach or breaches of the Occupational Health and Safety Act whether by the Contractor or any of the Contractor's sub-contractors may result in the immediate termination of this contract.

.6 The Contractor shall allow access to the Work site on demand to representatives of the Owner to inspect Work sites to ensure compliance with the Occupational Health and Safety Act.

.7 The Contractor agrees that any damages or fines that may be assessed against the Owner by reason of a breach or breaches of the Occupational Health and Safety Act by the Contractor or any of the Contractor's sub-contractors will entitle the Owner to set-off the damages so assessed against any monies that the Owner may from time to time owe the Contractor under this contract or under any other contract whatsoever.

.8 Ontario Regulation 213/91 (Construction Projects) and the following regulations under the Act and standards may also affect execution of the terms of the contract:

.1 Ontario Regulation

.1 Confined Spaces Requirement in the Regulation for Construction Projects (Reg 628/05)

.2 Confined Spaces (Reg 632/05)

.3 Control of Exposure to Biological or Chemical Agents (Reg 833)

.4 Critical Injury - Defined (Reg 834)

.5 Designated Substance - Asbestos on Construction Projects (Reg 278/05)

.6 Designated Substance - Vinyl Chloride (Reg 846)

.7 Roll-Over Protective Structures (Reg 856)

.8 Workplace Hazardous Materials Information System - WHMIS (Reg 860)

.9 First Aid Requirements (Reg 1101)

.2 Canadian Standards Association (CSA)

.1 CAN/CSA-Z259.1 Body Belts and Saddles for Work Positioning and Travel Restraint.

.2 CAN/CSA-Z259.10 Full body Harnesses.

.3 CAN/CSA-Z259.11 Energy Absorbers and Lanyards.

.4 CAN/CSA-Z259.2.1 Fall Arresters, Vertical Lifelines and Rails.
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.5 FCC No. 301 Standard for Construction Operations.

.6 CSA Z275.2 Occupational Safety Code for Diving Operations.

.7 CSA Z275.4 Competency Standard for Divers Operations.

.8 CSA Z797, Code of Practice for Access Scaffold.

.2 The Contractor shall provide a list of all controlled hazardous materials or products containing hazardous materials, all physical agents or devices or equipment producing or omitting physical agent and any substance, compound, product or physical agent that is deemed to be or contains a designated substance in accordance with the Workplace Hazardous Materials Information System (WHMIS) as defined under the Ontario Occupational Health and Safety Act and shall provide appropriate Material Health and Safety Data Sheets for these substances used for the performance of the required Work, all prior to the performance of the Work.

.3 Where hazardous materials, physical agents and/or designated substances are used in the performance of the required Work, the successful Contractor shall ensure that the requirements of the Ontario Occupational Health and Safety Act and associated regulations are complied with.

.4 The Owner reserves the right to cancel any contract for non-compliance with the terms set out herein, health and safety regulations, the Environmental Protection Act, associated regulations, and other applicable legislation.

.5 The Contractor shall perform the Work so as to cause the public the least inconvenience possible. In particular, the Contractor shall not obstruct any street, thoroughfare, or foot walk longer or to a greater extent than necessary.

.6 The Contractor shall take all reasonable precaution necessary to ensure the safety of the Workers and the general public, particularly children who may play in the area of Work.

1.2 SUBMITTALS

.1 Submit project specific Health and Safety Plan within **two (2) weeks** after date of Contract Award.

.2 Prepare a detailed project specific Health and Safety Plan that shall identify, evaluate and control job specific hazards and the necessary control measures to be implemented for managing hazards. The project specific Health and Safety Plan must address the items as outlined following:

.1 Engineering and administrative demonstrative controls (work-practices and procedures) to be implemented for managing identified and potential hazards, and comply with applicable federal and provincial legislation and more stringent requirements that have been specified in these specifications, including:

.1 Define work tasks and objectives of site activities/operations and the logistics and resources required to reach these tasks and objectives.

.2 Establish personnel requirements for implementing the plan, and

.3 A personal protected equipment (PPE) Program which shall detail PPE:

.1 Selection criteria based on site hazards.

.2 Use, maintenance, inspection and storage requirements and procedures.

.3 Decontamination and disposal procedures.

.4 Inspection procedures prior to during and after use, and other appropriate medical considerations.

.5 Limitations during temperature extremes, heat stress and other appropriate medical consideration

.4 An organizational structure which shall establish the specific chain of command and specify the overall responsibilities of contractor's employees at the work site.

.1 Project specific safety hazard assessment and hazard analysis for each site task and operation along with the identified mitigating factors.

.2 CAD 7 report from the Workplace Safety & Insurance Board outlining the accident history for the last 3 years, or a summary of accident history for the last 3 years.

.3 Construction Safety Checklists after completion.

.4 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.

.5 Material Safety Data Sheets (MSDS) and documentation on the safe handling procedures for any "hazardous" materials or chemicals that the Contractor, sub-contractors, or representatives, plan to bring on site.

.6 Submit, and post at the Work site, the emergency numbers for police, fire and ambulance for the locale of the Work, as well as the names and after-hours numbers for key site personnel related to health, safety or security of the site.

.7 All necessary health and safety permit, notifications and TSSA license certifications.

.3 Personnel training requirements including as follows:

.1 Names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.

.2 Work practices by which personnel can minimize risks from hazards, safe use of engineering controls and equipment on site including recognition of symptoms

and signs, which might indicate overexposure to hazards, and elements of site-specific Health and Safety Plan.

.3 Site control measures to be employed at site including site map, site work zones, use of 'buddy system', site communications including site security, alerting means for emergencies, standard operating procedures or safe work practices, and identification of nearest medical assistance.

.4 Emergency response requirements addressing: Pre-emergency planning, personnel roles, lines of authority and communication, emergency recognition and prevention, safe distances and places of refuge, site security and control, evacuation routes and procedures, emergency medical treatment and first aid, emergency alerting and response procedures, critique of response and follow-up, emergency equipment, site topography, layout, prevailing weather conditions, and procedures for reporting incidents to local, provincial, or federal agencies.

.5 Written respiratory protection program for applicable project activities.

.6 Procedures for dealing with heat and/or cold stress.

.7 Confined space entry procedures.

.8 Spill containment program if drummed waste material is generated, excavated, stored, or managed on site.

1.3 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

.2 Submit hazard assessment report to Engineer.

1.4 MEETINGS

.1 Attend health and safety preconstruction meeting.

.2 Arrange for "toolbox" safety meetings and submit reports.

1.5 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Program based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Program must address project specifications.

.2 Correct deficiencies and re submit Health and Safety Program when so requested by Engineer.

1.6 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial, and local statutes, regulations, and ordinances, and with site specific Health and Safety Program.

1.7 UNFORSEEN HAZARDS

.1 Should any unforeseen or peculiar safety related factor, hazard, or condition become evident during performance of Work, immediately stop work and follow procedures in place for employee's right to refuse work in accordance with the OH&S Legislation. Advise Engineer verbally and in writing.

1.8 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by Engineer or designated safety inspector.

.2 Provide Engineer with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Be aware that Engineer may stop Work if non-compliance of health and safety regulations is not corrected.

1.9 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

.2 Stop Work when necessary or advisable for reasons of health and safety.

.3 Be aware that Engineer or designated safety inspector may stop Work when deemed necessary or advisable for reasons of health and safety.

1.10 OVERLOADING

.1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

1.11 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province and authority having jurisdiction, and in consultation with the Engineer and the Owner.

1.12 SAFETY EQUIPMENT

.1 Ensure workers on the jobsite use personal protective equipment appropriate to the hazards identified in the project specific Health and Safety Plan and those workers are trained in the proper care, use, and maintenance of such equipment.

.2 PPE selections shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, task-specific conditions, duration and hazards and potential hazards identified on site.

.3 Provide all workers and up to five (5) visitors to the site with proper hearing protection. Workers and visitors shall not be exposed to noise levels greater than 85 dB (A) over an eight hour shift without proper hearing protection, in accordance with the Hearing Conservation Program.

.4 Provide all workers and up to five (5) visitors to the site with CSA approved eye protection sufficient to act as a protective barrier between the eye and airborne contaminants, hazardous materials and physical hazard.

.5 Provide workers and up to five (5) visitors to the site with CSA approved hard hats meeting the CSA Z94.1.

.6 Provide high visibility apparel as defined in Occupational Health and Safety Regulations and CSA approved safety boots meeting CSA Z195.

.7 Provide other personal protective equipment, as may be required, depending on duties being performed such as gas detection equipment for explosive or toxic gases or oxygen deficiency, safety belts, ropes, etc., are to be made available to the inspection staff.

.8 Provide and maintain a suitable detection meter. Use this meter continuously. Calibrate the meter to sound an alarm at a preset warning level.

.9 Metering for Toxic and /or Combustible Gases. And Oxygen Deficiency

.1 Supply and maintain portable combustible gas detection meter, MSA Passport Personal 4-in-1 Alarm Kit Gas Monitor including battery charger, or approved equal, to continuously monitor for toxic and combustible gases, atmospheric hazards, and oxygen deficiency in the surrounding atmosphere. Set meter to sound alarm at a preset warning level. Recharge meter batteries after each 8 hours maximum period of use.

.2 Provide a minimum of two (2) meters for each hazardous location in which work is executed.

.10 Provide and maintain suitable fire fighting equipment when working in the designated hazardous locations. Train personnel in the use of fire fighting equipment.

1.13 HEAVY EQUIPMENT

.1 Ensure mobile equipment used on jobsite is of the type specified in OH&S Act and Regulations fitted with a Roll Over Protective (ROP) Structure and Falling Object Protective (FOP) Structure.

.2 Obtain written clearance from the power utility where equipment is used in close proximity to (within 5.5 metres) overhead or underground power lines.

.3 Equip cranes with:

.1 A mechanism which will effectively prevent the hook assembly from running into the top boom pulley.

.2 A legible load chart.

.3 A maintenance log book.

1.14 FALSEWORK

.1 Design and construct falsework and formwork in accordance with CSA S269.1.

1.15 SCAFFOLDING

.1 Design, erect, inspect, operate, modify, and dismantle scaffolding in accordance with CSA Z797, the OH&S Act and Regulations, and the scaffold manufacturer's written instructions.

.2 Provide trained and certified Competent Scaffold Erectors for all scaffold erection, modification and dismantling.

.3 Conduct and document daily inspections of scaffolding by trained and certified Competent Scaffold Inspectors or Erectors.

.4 Provide a scaffold tagging system as described in CSA Z797.

.5 Ensure that all industry best practices for safe scaffold usage, including fall protection, proper loading, safe access, electrical hazards, exit door management and other concerns are strictly adhered to.

1.16 WORKING AT HEIGHTS

.1 Ensure that fall restraint or fall arrest devices are used by all workers working at elevations greater than 3.05 meters above grade or floor level in accordance with CSA Z259, where alternate fall protection systems are not provided in accordance with Occupational Health and Safety Act and Regulations.

.2 All workers performing work at height and who will be required to utilize a fall arrest system must be trained in a fall protection program certified by the WHSCC.

.3 Prior to working at height workers shall be instructed in a Contractor SWP for working at height and associated rescue plan for working at height developed specific to the work, locations and risks.

1.17 WORK IN CONFINED SPACE

.1 Hazardous Locations are to be classified and managed as Confined Spaces (as defined by O. Reg. 628/05 and 632/05, OHSA). All work and entry into the identified Confined Spaces is to be done in accordance with the Regulations (O. Reg. 628/05 and 632/05).

.2 Contractor is responsible for all confined space entry permitting, assessment, entry, control, and rescue planning in accordance with the Regulation.

.3 Contractor shall maintain all appropriate documentation required under the Regulation (including copy of an "Entry Permit" for each entry into the confined space) and provide daily copies to the Engineer.

.4 All work areas suspected of containing explosive or toxic gases or that are oxygen deficient must be routinely tested for presence of same before any work is done. Make safe any work area that is found hazardous before any work may proceed, in accordance with safe practice and applicable statutes.

.5 Provide appropriate safety equipment and confined space entry equipment including but not limited to ropes, safety belts, combustible/hazardous gas and oxygen depletion meter for the use of the resident inspection staff. Provide labour to assist Engineer when entry is

required to manholes or other areas, which may be hazardous. Engineer is not permitted to enter such areas alone.

.6 Ensure that all personnel engaged in confined space work or work in hazardous locations that require the use of respiratory equipment, comply with the requirements of the Ministry of Labour and must be clean shaven.

1.18 HAZARDOUS MATERIALS

.1 Post warning signs at location where hazardous materials are stored, and install protective barriers, instruct personnel in proper safety procedures.

.2 Only non-sparking tools may be used in potentially explosive areas.

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

.4 The Contractor shall inform the Owner of the location of these materials and shall ensure that these materials are not kept stored or used on site without the Owner's prior consent or approval.

1.19 EXPLOSION-PROOF CONSTRUCTION

.1 Certain areas may be designated on the Drawings as "explosion proof", "hazardous", or may be classified under Section 18 of OESC CSA C22.1. Where areas have such designation, provide explosion proof electrical equipment that meets the requirements of OESC CSA C22.1, Section 18 and NFPA 820 regulations.

.2 In hazardous areas as defined above, provide intrinsically safe mechanical devices and equipment such as, but not limited to non sparking aluminum wheels for fans, pneumatic operators for dampers and aluminum clappers for check valves on pipelines conveying gaseous fuels.

1.20 FIRE PROTECTION

.1 Combustibles shall not be introduced into the plant and environs until required fire protection is in service.

.2 Contractor shall place all new fire protection in service as soon as possible and notify the Engineer upon completion of all new fire protection services.

.3 Contractor shall provide adequate supplementary fire protection facilities including but not limited to hand-operated 15 to 20 pound multi-purpose dry chemical extinguishers adequately distributed in the plant. Temporary hose lines shall be connected in areas where construction is in progress until the permanent fire protection can be placed in service. Hydrant hose connections and other fire fighting equipment shall not be blocked by construction equipment and must be readily accessible at all times.

.4 Contractor shall dispose of all combustible rubbish promptly and safely, particularly material subject to spontaneous ignition such as oily waste and paint rags.

.5 Potential ignition sources shall be controlled and monitored as necessary by Contractor, to prevent fires.

.6 Hot work, including but not limited to operations involving open flames or producing heat and/or sparks, such as brazing, cutting, grinding, soldering, and torching, shall be minimized. If there is a practical and safer way to do the work without hot work, the alternative method shall be used.

1.21 SITE CONDITIONS

.1 Work at site may involve contact with:

.1 Sodium Hypochlorite
.2 Aluminum Sulphate
.3 Ferrie Chloride
.4 Hydrofluosilicic Acid
.5 Sodium Bisulphite
.6 Polyelectrolite
.7 Diesel Fuel
.8 Methane gas
.9 Hydrogen sulfide gas (H2S)
.10 High Voltage Electricity

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Be responsible for the performance and commissioning of all equipment supplied under this Contract. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.

.2 In consultation with the Owner, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all process, mechanical, electrical, instrumentation and controls, and SCADA systems.

1.2 PERFORMANCE VERIFICATION OBJECTIVE

.1 Period of time of Performance Verification for acceptance of continuous automatic operation with all systems operating continuously 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 shall be:

.1 **Two weeks**

.2 Successful completion of the Performance Verification commissioning is a requirement of Substantial Completion of the project.

1.3 DEFINITIONS

.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 shall conduct inspections of all components and sub-components and shall 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 shall obtain completed Equipment Installation Certification Forms for each specified piece of equipment and shall submit these to Owner for review. Once Owner 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 shall be placed on the equipment designating that the Pre-Start-Up Phase for that particular system is complete.

.2 **Start-Up:** Once each piece of equipment within a defined system carries a "Ready-to-Start" tag, then that individual system shall be started and tested. Both "Dry-Run" and "Wet-Run" tests are required. Contractor shall conduct performance tests of all equipment in conjunction with the manufacturers' representatives as required by the Contract Documents and under the witness of Owner. Deficiencies that are uncovered shall be corrected and retesting shall be conducted as required. Start-Up Completion Certificates shall be prepared by Contractor certifying that the equipment or system is

complete, successfully tested, started and ready for commissioning and continuous operation.

.3 **Commissioning:** Commissioning consists of placing all the various systems in Work into continuous operation in an orderly manner. Contractor is responsible for the commissioning activities and shall have equipment manufacturer representatives at the site, as well as qualified mechanical, electrical, control and instrumentation personnel. Contractor may be assisted by Owner relative to process considerations and by Owner's operations and maintenance staff. Commissioning is considered to be complete when all systems have been operating continuously without fault and in accordance with the specified performance requirements.

1.4 COMMISSIONING (CX) GENERAL

.1 Acronyms:

.1 AFD - Alternate Forms of Delivery, service provider.
.2 BMM - Building Management Manual.
.3 Cx - Commissioning.
.4 EMCS - Energy Monitoring and Control Systems.
.5 O&M - Operation and Maintenance.
.6 PI - Product Information.
.7 PV - Performance Verification.

.2 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.

.1 Objectives:

.1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
.2 Ensure appropriate documentation is compiled into the O&M Manuals.
.3 Effectively train staff.

.3 Contractor is the lead in the Cx process, operating equipment and systems, troubleshooting and making adjustments as required.

.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
.3 Report conflicts between requirements of this section and other sections to Engineer before start-up and obtain clarification.

.1 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

.4 Design Criteria: as per client's requirements or determined by designer. To meet functional and operational requirements.

1.5 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule.

.2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

.1 Approval of Cx reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

1.6 QUALITY CONTROL

.1 When specified in individual Sections of Contract Documents, require equipment manufacturer or supplier is to provide authorized technical representative(s) with testing, start-up and commissioning experience on their equipment. The Testing and Commissioning Manager is to ensure that the necessary technical individuals are present for each system as required to facilitate this process and minimize delays.

.2 Testing:

.1 Provide all required testing equipment and ancillary equipment to verify specified performance.

.2 Calibrate all test equipment to plus or minus two percent (2%) of actual value at full scale.

.3 Employ recognized, industry standard calibration procedures or as specified in individual Sections.

.4 Submit calibration plans and results to Owner.

.3 Attend and participate in Pre-start-up, Start-up and Commissioning workshops with Owner.

1.7 SAFETY

.1 Ensure all requisite safety equipment, devices, detectors, materials and procedures are in place, tested and operational before commencing.

.2 Conform to requirements of all regulatory authorities having jurisdiction.

.3 Maintain communications with fire, police, environmental and health authorities.

1.8 ENVIRONMENTAL PROTECTION

.1 Comply with all requirements of federal, provincial and local jurisdictions having authority.

1.9 MANUFACTURER'S INVOLVEMENT

.1 Contractor's Cx Agents to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

.2 Factory testing: manufacturer to:

.1 Coordinate time and location of testing.

.2 Provide testing documentation for approval by Engineer.

.3 Arrange for Engineer to witness tests.

.4 Obtain written approval of test results and documentation from Engineer before delivery to site.

.3 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Engineer. Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.1 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.4 Integrity of warranties:

.1 Use manufacturers' trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

.5 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 To report results in clear, concise, logical manner.

1.10 PRE-START UP

.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.

.2 Identify all pieces of equipment by Tag Numbers.

.3 Remove all scaffolding, debris, planks tools and other construction-related material.

.4 Remove all sand, silt, dirt and debris from tanks, channels, chambers, instrumentation and control panels and electrical panels and vacuum clean.

.5 Clean all surfaces of tanks and conduits, including walls, roofs, floors and columns with high pressure water jets or as specified in individual Sections.

.6 Clean interior of all pipes and fluid-carrying equipment, including pumps and inspect with Owner present.

.7 Provide photographic evidence (electronic copy and hardcopy) and/or digital video survey of pipes along with written report to Owner for approval.

.8 Conduct leakage and pressure tests in accordance with individual Sections.

.9 Conduct disinfection procedures in accordance with requirements of individual Sections.

.10 Provide Checkout Tag for each piece of equipment.

.11 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.

.12 Equipment Manufacturer's Representatives to inspect equipment in accordance with applicable individual Sections. Certify equipment has been properly installed and is ready to start.

.13 Contractor to submit Equipment Checkout Listing to Owner. 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).

.14 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.

.15 Request, in writing, a Pre-Start-Up Inspection by Owner. Once Owner 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.

.16 Provide Operating and Maintenance Manuals as required by individual Sections.

1.11 START-UP

.1 Conduct workshop with Owner 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 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 systems' 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.

.2 Develop Owner Training plan and implement.

.3 Conduct Dry Run Tests for all equipment, witnessed by Owner.

.4 Conduct Wet Run Tests for all equipment, witnessed by Owner.

.5 Correct any deficiencies uncovered during testing.

.6 Provide Pre-Commissioning Certification Form.

1.12 COMMISSIONING

.1 Assemble Contractor's commissioning team to respond to requests for assistance by Owner. Team to consist of representatives of Contractor and Contractor's mechanical, electrical and instrumentation staff or subcontractors, as appropriate.

.2 Contractor's representative and commissioning team to be at site during normal working hours for entire commissioning period. 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 and shall be available 8 hours per day, 5 days per week, and within four (4) hours' notice at all times.

.3 Remove and clean or replace as required all permanent and temporary filters and strainers in pipeline systems; replace HVAC filters; dewater and clean sumps and leave process systems clean and filled with clean water, unless otherwise directed by Owner.

.4 Commission Work in stages based on 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

.5 Commissioning to be generally conducted in Local / Manual mode first, followed by Remote / Manual mode and thereafter Remote / Auto mode.

.6 Period of time for continuous automatic operation for acceptance of commissioning is minimum 336 hours (14 days) per device with all systems operating continuously 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.

.7 Failure of any part of Work during the period of continuous automatic operation will require restart of that portion or system of Work, following rectification of the fault or failure.

.8 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 shall be paid by Contractor.

.9 The Commissioning Period is that period of time required to put the Work into continuous operation, to the satisfaction of Owner.

.10 Procedures:

.1 Give Owner minimum 48 hours prior notice before commencing commissioning procedures.

.2 Commission Work in an orderly fashion, system by system, where system is defined as an integral operating entity or loop.

.3 Make adjustments to equipment and other works, as necessary to place Work into operation.

.4 Trial operation:

.1 Trial operate all units.

.2 Check mechanical operation.

.3 Check for overload and undue vibration.

.4 Make necessary adjustments.

.5 Initial operation:

.1 Operate pumping units at design load.

.2 Check operation for alignment, clearance and rigidity.

.3 Make necessary adjustments.

.6 Alignments:

.1 Break open couplings between drivers and pumps after run-in period.

.2 Check alignments.

.7 Calibrate instrument primary elements, such as flow and pressure transmitters.

.8 Tune control loops to optimum performances by adjusting the action of pneumatic controllers.

.9 Make final adjustments to the setpoints of field mounted pressure, level and temperature switches.

1.13 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within

the non-functional system, including related systems as deemed required by Engineer, to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

.3 Report problems, faults or defects affecting Cx to Engineer in writing. Stop Cx until problems are rectified. Proceed with written approval from Engineer.

1.14 TEST RESULTS

.1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

Part 2 Products

.1 Not used

Part 3 Execution

.1 Not Used

END OF SECTION

Part 1 General

1.1 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.

1.2 GENERAL

.1 Prepare two (2) copies of documentation including as-constructed shop drawings to instruct Owner's operations and maintenance staff in the operation and associated maintenance of each piece of equipment and system as supplied and installed.

.2 Submit a skeleton of the O & M Manual, including table of contents, section tabs, scale mock-up of printing proposed for the binders, sample of proposed record drawing storage mechanism, and O & M material from the equipment supplier to the Engineer for approval for each individual process system during the respective pre-startup period. No payment over 70% of the Contract value for that particular individual process system will be made until this is received.

.3 Submit the completed O & M Manuals before 90% of the work is approved for payment. No payment for any work will be made over 90% of the Contract value of the overall project until completed O & M Manuals are received and accepted as satisfactory.

1.3 BINDERS

.1 Provide the material in a black expanding catalogue binder. Binders to be suitably labelled on spine and cover. The catalogue binder shall be Casemade Catalogue Binder P5400 as manufactured by Acco Canada Inc. or approved alternative.

.2 **Contractor to supply a sample of the binder with spine and cover labelling for Engineer and Owner approval prior to submission of final O & M Manuals.**

1.4 CONTENTS

.1 Arrange the material in volumes as described below. Provide a separate binder for each volume unless directed otherwise by Engineer. Where more than one (1) binder is required to accommodate the documentation for a volume, increase or decrease the number of volumes and renumber as necessary:

Volume 1 - Process Mechanical Operations and Maintenance

Volume 2 - Electrical and Instrumentation Operations

.2 Permanently number each set.

.3 Letter the spine of the binder with the full identification title of the project and the front face with the following on the respective binders:

.1 Full identification title of the project

.2 Volume Number

.3 Volume Title

.4 City name

.5 Number of Sets (i.e., 1 of 3)

.4 Arrange the binders according to the Construction Specifications Institute MASTERFORMAT - Master List of Sections, Titles and Numbers, utilizing laminated mylar plastic divider tabs, colour coded according to section. Markings on the tabs are to be type written. Tab colours are to be as follows:

.1 Division - white

.2 Sections - orange

.3 Subsections - yellow

.5 Make up each binder as follows:

.1 Tab: Table of Contents - details the titles of various divisions of the manual in the binder.

.2 Tab: Introduction to manual - written explanation of the layout of the manual and intended use.

.6 Include separately the following:

.1 Consultant: name, address, telephone, name of Project Manager.

.2 Contractor: name, address, telephone, name of Project Manager.

.3 Major Sub-Contractors: name, address, telephone of sub-contractors included in that binder.

.7 Provide the following for each respective discipline:

.1 Tab: Division number xx:

.2 Index - information in that division in order of appearance in the specification.

.3 List of sub-contractors and suppliers - name, address, and telephone.

.4 Specification section cross-reference.

.5 Drawing List.

.8 Organize the various applicable sections under separate divider tabs labelled division/number as required by the project.

.9 Provide the information given below, where applicable, 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, using a non fading marker, 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; characteristic 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.

.4 Troubleshooting data.

.5 Preventative maintenance program complete with:

.1 Suggested check list sheets.

.2 List of points to be greased or oiled.

.3 Recommended type, grade and temperature range of lubricants.

.4 List of wear points to be inspected and/or adjusted regularly.

.5 Suggested schedule for lubrication and inspection

.6 Schematic, single line, and wiring diagrams.

.7 Valve tag list.

.8 Recommended spare parts list.

.9 Certification, guarantee, warranty.

.10 Service representatives: Name, address and telephone number.

.11 Suppliers for replacement parts: Name, address, and telephone numbers.

.12 Test results: Witness testing and commissioning and provide reports.

.13 Test data for piping systems (degreasing, flushing, disinfection).

.14 Hydrostatic or air tests performance.

.15 Equipment alignment certificates.

.16 Balancing data for air and water systems.

.17 Inspection approval certificates for all types of systems; plumbing and piping, hot air and ventilating, electrical supervisory, etc.

.10 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 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 MASTERFORMAT. Identity any material located in the file cabinet as such in the appropriate location in the binders.

.11 At Engineer's discretion, provide the information in plastic map pockets in appropriate sections in the binders.

Part 2 Products

.1 Not Used

Part 3 Execution

.1 Not Used

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This section contains requirements for training the plant operating staff, by persons retained by the Equipment Supplier in coordination with General Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

.2 Commissioning will not be approved to commence until the training requirements have been met and approved by the Owner.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of final substantial performance.

.2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.

.3 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:

Item	Equipment	Duration
.1	Electrical and Control Systems (includes VFDs)	4 hours
.2	Process Mechanical Pumps	4 hours

1.3 QUALITY ASSURANCE

.1 Where required by the detailed specifications, provide on-the-job training of the plant operating staff. The training sessions shall be conducted by qualified, experienced (two (2) years minimum), factory-trained representatives of the various equipment manufacturers. Training shall include instruction of operating personnel in equipment operation and preventive maintenance and instruct plant mechanics, electricians, and electronics technicians in normal maintenance up to major repair.

1.4 SUBMITTALS

.1 The following information shall be submitted to the Engineer. Due to phased testing and start-up activities, separate submittals can be prepared for equipment items or systems. The material shall be reviewed and accepted by the Engineer no later than three (3) weeks prior to delivery of the training.

.1 Lesson plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.

.2 Date, time, and subject of each training session and identity and qualifications of individuals to be conducting the training.

.3 Training schedule. Concurrent classes will not be allowed.

.4 Signed-off Owner 'On the Job Training Attendance Sheet'. This must be submitted after each completed training session and also included in the training manual.

.5 Resume of trainer(s).

Part 2 Products

2.1 GENERAL

.1 Conduct training sessions for the operation and maintenance personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Vendor operation and maintenance manuals, as defined in Specifications, shall be available to the owner's personnel at least 30 days prior to the date scheduled for the individual training session.

2.2 LOCATION

.1 Field training sessions shall take place at the Kenora WTP.

Part 3 Execution

3.1 GENERAL REQUIREMENTS

.1 Training shall be conducted in a separate visit from the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. Arrange to have the training conducted on non-consecutive days, with no more than four (4) hours of classes scheduled for any one (1) day.

3.2 OPERATIONS AND MAINTENANCE PERSONNEL HANDS-ON TRAINING

.1 As a minimum, hands-on equipment training for operations and maintenance personnel will include:

.1 Identify location of equipment and review the purpose.

.2 Review the equipment function and theory of operation.

.3 Identifying piping and flow options.

.4 Identifying valves and their purpose.

.5 Identifying instrumentation:

.1 Location of primary element.

.2 Location of instrument readout.

.3 Discuss purpose, basic operation, and information interpretation.

.6 Discuss, demonstrate, and perform standard operating procedures and round checks.

.7 Discuss and perform the preventative maintenance activities.

.8 Discuss and perform start-up and shutdown procedures.

.9 Perform the required equipment exercise procedures.

.10 Perform routine disassembly and assembly of equipment if applicable.

.11 Identify and review safety items and perform safety procedures.

.12 Review normal repair procedures.

.13 Perform Owner approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

.14 Review and use equipment manufacturer's manuals in the hands-on training.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section refers to formwork and falsework for concrete works.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA-O86S1, Supplement No. 1 to CAN/CSA-O86, Engineering Design in Wood.
- .3 CSA O121, Douglas Fir Plywood.
- .4 CSA O151, Canadian Softwood Plywood.
- .5 CSA O153, Poplar Plywood.
- .6 CAN/CSA-O325.0, Construction Sheathing.
- .7 CSA O437 Series, Standards for OSB and Waferboard.
- .8 CSA S269.1, Falsework for Construction Purposes.
- .9 CSA-S269.2 - Access Scaffolding for Construction Purposes.
- .10 CAN/CSA-S269.3, Concrete Formwork, National Standard of Canada
- .11 NLGA - Standard Grading Rules for Canadian Lumber.

.2 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 DESIGN REQUIREMENTS

.1 Comply with requirements of CSA S269.1, CSA-S269.2, and CSA-S269.3.

.2 Take full responsibility for the design, construction, inspection and maintenance of formwork and falsework.

.3 Design formwork and falsework to carry dead loads and construction live loads.

.4 Where high-slump or superplasticized concrete is used, design formwork and falsework for full hydrostatic pressure.

.5 Limit deflections of formwork to tolerance limits in accordance with CSA-S269.3.

1.4 QUALIFICATIONS

.1 Formwork to be done by an established firm having at least five years of proven, satisfactory experience in the trade, and employing skilled personnel.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit Shop Drawings for all formwork and falsework bearing the signature and seal of a Professional Engineer registered or licensed in the Province of Ontario. Submitted Shop Drawings will be for record purposes and will not be reviewed by the Engineer.

.2 Indicate method and schedule of construction, design loads, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1 for falsework drawings and CAN/CSA-S269.3 for formwork drawings. Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

.3 Submit manufacturer's product data sheets including installation, application, and maintenance instructions for:

.1 Lumber for formwork and falsework.

.2 Plywood for formwork and falsework.

.3 Form release agent.

.4 Indicate sequence of erection and removal of formwork/falsework as directed by Engineer.

Part 2 Products

2.1 MATERIALS

.1 Formwork materials:

.1 Lumber for formwork and falsework: Grade-marked sawn lumber graded in accordance with NLGA and CAN3-0121.

.2 Plywood for formwork: CSA A23.1; high density overlay grade plywood

.3 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, CSA O437 Series, CSA-O153.

.4 Pan forms: removable as indicated.

.2 Form liner:

.1 Plywood: medium density overlay Canadian Softwood Plywood to CSA O151

.3 Form release agent: shall not leave a residue, discolour, or stain concrete surface. Form release agent shall be compatible with final coating or waterproofing if applicable.

.1 Acceptable products: RICH-COTE by NCA/Acrow-Richmond Ltd., Sealtight Duogard by W.R. Meadows of Canada Ltd., or Eucoslip VOX by Euclid Admixture Canada, Inc. All other products subject to approval by the Engineer.

.4 Chamfer strips: Unless where shown otherwise, cut chamfer strips either from sawn lumber or extruded polyvinyl chloride and shall be 25 mm × 45º.

Part 3 Execution

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels, and centres before proceeding with formwork/falsework and ensure dimensions agree with Contract Drawings.

.2 Fabricate and erect falsework in accordance with CSA S269.1.

.3 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.4 Align form joints and make watertight.

.1 Keep form joints to minimum.

.5 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.

.6 Form chases, slots, openings, drips, recesses, expansion, and control joints as indicated.

.1 Continuous, pre-formed flashing reglets to forms where built in flashings occur at concrete surfaces.

.2 Where final work will be exposed to view, set form ties in neat regular patterns.

.7 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

.1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.8 Line forms for following surfaces:

.1 Secure lining taut to formwork to prevent folds.

.2 Pull down lining over edges of formwork panels.

.3 Ensure lining is new and not reused material.

.4 Ensure lining is dry and free of oil when concrete is poured.

.5 Application of form release agents on formwork surface is prohibited where drainage lining is used.

.6 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.

.7 Cost of textile lining is included in price of concrete for corresponding portion of Work.

.9 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 **7 days** for walls and sides of beams.

.2 **7 days** for columns.

.3 **14 days** for beam soffits, slabs, decks and other structural members, or 7 days when replaced immediately with adequate shoring to standard specified for falsework.

.4 Time intervals given are the cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of the air in contact with concrete is above 10ºC and concrete has been damp or thoroughly sealed from evaporation and loss of moisture.

.5 Time periods for walls and beam side forms may be reduced to three days if acceptable curing and cold weather protection is provided. Submit alternatives to Engineer for review.

.2 In cold weather, the minimum time interval may be governed by the requirements for protection of concrete as specified elsewhere in these specifications. Generally, the minimum time interval may be governed by curing requirements of Section 03 30 00 Cast-In-Place Concrete.

.3 Remove formwork when concrete has reached 70% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

.4 Provide 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.

.5 Space reshoring in each principal direction at not more than 3000 mm apart.

.6 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section covers concrete reinforcement.

.2 This section shall be read in conjunction with:

.1 Section 03 30 00 – Cast-In-Place Concrete.

.2 Section 03 60 00 – Grouting

.3 Note that this is a general Specification and that some of the items herein may not be applicable to this Contractor.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

.2 ASTM A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

.3 ASTM A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

.4 ASTM A775/A775M, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

.2 CSA International

.1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A23.3, Design of Concrete Structures.

.3 CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement.

.4 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.6 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC, Reinforcing Steel Manual of Standard Practice.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.

.3 Shop Drawings:

.1 Indicate placing of reinforcement and:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement, with identifying code marks to permit correct placement without reference to structural drawings.

.5 Indicate sizes, spacings and locations of chairs, spacers and hangers.

.2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

.1 Provide Class B tension lap splices unless otherwise indicated. All splices to be contact lap splices unless shown otherwise.

.4 Quality control submittals:

.1 Submit certified mill test reports of steel reinforcing bars.

.2 Submit manufacturer's test reports for epoxy-coated steel reinforcing bars, if any.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Ship bundles of reinforcing bars identified by tags containing bar marks along with bar list.

.2 Store materials in a manner, which will prevent deterioration or contamination. Deteriorated or contaminated materials will be rejected and shall be removed from site.

1.5 SUBSTITUTES

.1 Substitution of different size bars permitted only upon written authorization from the Engineer.

Part 2 Products

2.1 MATERIALS

.1 Reinforcing steel: Billet steel grade 400 W for all bars, including stirrups, ties and spirals, deformed bars free from mill scale and rust and to CSA G30.18 unless indicated otherwise.

.2 Welded steel wire fabric: to ASTM A185/A185M.

.3 Dowel bar splicer: Dowel bar splicers with plastic setting plugs; DB SAE by NCA/Acrow Richmond Ltd., Lenton Form Saver by Erico Canada Inc., or D50 DBR Coupler and DBR Setting Splice Bar, with size equivalent to DB SAE, by Dayton Superior Canada Limited or approved alternate.

.4 Dowel in bar: Suitable for existing dowel bar splicer with rolled UNC or tapered threads as required; DI by NCA/Acrow Richmond Ltd., Splice bar by Erico Canada Inc., or D 51, D 52, or D 53, with size equivalent to DI, by Dayton Superior Canada Limited or approved alternate.

.5 Mechanical splices: Restrict to use on dowels from wall to slab and locations agreed upon by the Engineer.

.6 Plain round bar: To CSA-G40.21.

.1 Tie wire: steel soft wire of 1.6 mm diameter with plastic or epoxy coated.

.2 Chairs, bolsters, bar supports, spacers: Adequate for strength and support of reinforcing construction conditions.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Obtain The Engineer's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of The Engineer, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement clearly identified in accordance with bar bending details and lists.

.1 Ship epoxy coated bars in accordance with ASTM A775A/A775M.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Engineer with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request inform Engineer of proposed source of material to be supplied.

Part 3 Execution

3.1 PREPARATION

.1 Galvanizing to include chromate treatment.

.1 Duration of treatment to be 1 hour per 25 mm of bar diameter.

.2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by the Engineer.

.2 When field bending is authorized, bend without heat, applying slow, and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.3 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1.

.2 Clean bars free from loose rust, mud, oil or other bond-reducing coatings.

.3 Inspect bars if concrete placing is delayed, and re-clean, if necessary, before resumption of concreting.

.4 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.

.5 Prior to placing concrete, obtain Engineer's approval of reinforcing material and placement.

.6 Ensure cover to reinforcement is maintained during concrete pour.

.7 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

.8 Placing bars on/or in layers of fresh concrete as the work progresses will not be permitted.

.9 Straighten existing dowels previously placed before placing steel in next sections. If dowels are bent excessively, review straightening procedure with the Engineer before carrying out the work.

.10 Do not weld chairs, bolsters, bar supports or spacers to reinforcement.

.11 Set and tie all individual bars in place. Pre-assembly of slab and wall mats and “flying” in place is not permitted.

3.4 REINFORCEMENT NOT SHOWN ON DRAWINGS

.1 In addition to reinforcement shown on the drawings, cover electrical conduit or other piping to be buried in concrete slabs with a 600 mm wide strip of WWM 100 mm x 100 mm - MW 13.3 x MW 13.3 before concreting.

.2 Provide horizontal corner bars at wall intersections and corners at the same spacing as the horizontal steel in a manner which renders the reinforcement continuous.

.3 Across each corner of every opening (including sleeves) in floors, provide two 15M bars; one in the top and one in the bottom of the slab unless noted otherwise on drawings. Extend bars 30 bar diameters beyond the opening. Circular openings shall be considered as a square opening with its side equal to the hole diameter.

.4 Around heads, sills and jambs of wall openings, extend two 20M bars 30 bar diameters beyond the edge of the opening unless otherwise shown on the drawings.

.5 Around slots and holes, extend 10M bars 30 bar diameters beyond the edge of the opening.

.6 Additional bars required for the proper support of reinforcement to be provided and placed by the Contractor.

.7 Where no reinforcing is indicated on drawing sections or details or specified on notes, provide minimum temperature and shrinkage reinforcing according to CSA.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This section refers to cast-in-place concrete works.

.2 Section 03 10 01 – Concrete Formwork and Falsework.

.3 Section 03 20 00 – Concrete Reinforcing.

.4 Section 03 35 00 – Concrete Finishing

.5 Section 03 60 00 – Grouting

.6 This section specifies the requirements for the supply of all labour, materials and equipment to complete the concrete works as indicated on the Contract Drawings, as specified herein, and as required in order to complete the works.

1.2 REFERENCES

.1 Abbreviations and Acronyms:

.1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.

.1 Type GU, GUb and GUL - General use cement.

.2 Type MS and MSb - Moderate sulphate-resistant cement.

.3 Type MH, MHb and MHL - Moderate heat of hydration cement.

.4 Type HE, HEb and HEL - High early-strength cement.

.5 Type LH, LHb and LHL - Low heat of hydration cement.

.2 Type HS and HSb - High sulphate-resistant cement.

.3 Fly ash:

.1 Type F - with CaO content less than 15%.

.2 Type CI - with CaO content ranging from 15 to 20%.

.3 Type CH - with CaO greater than 20%.

.4 GGBFS - Ground, granulated blast-furnace slag.

.2 Reference Standards:

.1 ASTM International

.1 ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C330, Standard Specification for Lightweight Aggregates for Structural Concrete.

.4 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.

.5 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.6 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

.7 ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

.8 ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.

.2 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 CSA International

.1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283, Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide testing for review by Engineer and do not proceed without written approval when deviations from mix design or parameters are found.

.2 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in Quality Assurance.

.3 Concrete hauling time: provide for review by Engineer deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.4 SUBMITALS

.1 Submit the mix design and sieve analysis of all aggregate to the Engineer for review a minimum of 10 days prior to delivery of any concrete to the site. The Engineer's review of mix design is of general conformance only, and in no way mitigates the contractor's obligation to provide concrete suitable for placing in the locations shown and meeting all specified requirements.

.2 Do not place any concrete until materials and mix design are reviewed, by the Engineer.

1.5 CERTIFICATES

.1 Ready mixed concrete Producer shall be a certified member in good standing of Ready Mixed Concrete Association of Ontario.

.2 Upon request by the Engineer, provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1 and specific CSA material Specifications.

.3 Provide certification and test results showing that mix proportions selected will produce concrete of specified quality, durability, volume stability and yield and that strength will comply with CSA-A23.1, Clause 4.3.

.4 Submit test results from samples of fine and coarse aggregate together with proposed mix designs in accordance with CSA-A23.2 prior to placing concrete. Mix designs shall be by a CSA certified testing laboratory. The full cost of tests on aggregates and all other materials, as well as the mix design, shall be included in the Total Tender Price.

1.6 QUALIFICATIONS

.1 Concrete work shall be done by an established firm having at least five years of proven, satisfactory experience in this trade and employing skilled personnel.

1.7 QUALITY ASSURANCE

.1 Provide Engineer, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

.2 Portland cement.

.3 Blended hydraulic cement.

.4 Supplementary cementing materials.

.5 Grout.

.6 Admixtures.

.7 Aggregates.

.8 Water.

.2 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Engineer on following items:

.1 Falsework erection.

.2 Hot weather concrete.

.3 Cold weather concrete.

.4 Curing.

.5 Finishes.

.6 Formwork removal.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.

.1 Do not modify maximum time limit without receipt of prior written agreement from Engineer and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by Engineer.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

.2 Waste Management and Disposal:

.1 Divert unused concrete materials from landfill to local facility approved by Consultant.

.2 Provide an appropriate area on the job site where concrete trucks can be safely washed.

.3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by the Consultant.

.4 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground, or in other location where it will pose health or environmental hazard.

.5 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

.2 28 Day or 56 Day Compressive strength as detailed in the Table of Concrete Properties and General Notes in Contract Drawings pertaining to Structural Details.

.3 Other mixes detailed in the Table of Concrete Properties and General Notes in Contract Drawings pertaining to Structural Details.

.4 Class of Exposure as detailed in the Table of Concrete Properties and General Notes shown on the Contract Drawings and Specifications.

.5 Concrete Mix as detailed in the Contract Drawings and Specifications.

.6 Normal density concrete unless specified otherwise in the Contract Documents.

.7 Bond strength of concrete toppings is not less than 1.2 MPa.

.8 Construction tolerances: Comply with CSA A23.1 unless noted otherwise in the Contract Documents.

2.2 PERFORMANCE CRITERIA

.1 Quality Control Plan: Ensure concrete supplier meets performance criteria of concrete as established by Engineer and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 CONCRETE MATERIALS

.1 Portland Cement:

.1 Type GU, CSA A23.1/CSA A23.2 normal Portland Cement. Slag cement as manufactured under CAN/CSA-A3000-13 - Cementitious materials compendium.

.2 Use of supplementary cementitious material will be considered, subject to review by the Engineer.

.3 Water: to CSA A23.1.

.4 Aggregates: to CSA A23.1/A23.2.

.1 Normal-density concrete:

.1 Coarse aggregate: CSA A23.1; rough and angular gravel or crushed stone.

.2 Fine aggregate: CSA A23.1; natural sand.

.5 Admixtures:

.1 Air entraining admixture: to ASTM C260.

.2 Chemical admixture: to ASTM C494. Engineer to approve accelerating or set retarding admixtures during cold and hot weather placing.

.6 Curing compound: to CSA A23.1/A23.2

.7 Polyethylene film: 0.15 mm thickness to CAN/CGSB-51.34.

.8 Use compatible additives, admixtures, curing compounds, and sealers.

2.4 BONDING AGENTS

.1 Two-component epoxy resin, compatible with potable water.

.1 Product: Sika Sikadur Hi-Mod, Grace Epoxtite Binder, Allied Coatings AC1201, Adhesive Engineering 1001 LPL, Sternson ST432, or Sternson ST 413.

2.5 GROUT

.1 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.

.1 Compressive strength: 32 MPa at 28 days.

.2 Non premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 32 MPa at 28 days.

2.6 CONCRETE MIXES

.1 Performance Method for specifying concrete: to meet Engineer performance criteria to CSA A23.1/A23.2. To give the following quality and yield for all concrete:

Mix	Application
M1	Interior main floor slab, curbs, and housekeeping pads

.2 Proportion normal density concrete in accordance with CSA-A23.1 Alternative 1 (Performance), to give following properties:

Mix	M1
CSA Exposure Class	N
Minimum Specified Strength (MPa)	35
Age (days) for Specified Strength	56
Maximum W/CM Ratio	0.40
Maximum Aggregate Size	20
Exposure to Sulphate Attack	N
Alkali Aggregate Reactivity Addressed (Y/N)	Y
Aggressive Chemical/Waste/Other	N
Air Content Category	None
Curing	1
Color (Y/N)	N
SCM Usage (Y/N)	Y
Fly Ash Class (30% maximum)	F or C1

.3 Temperature: Concrete when placed to at least 10ºC but not above 30ºC.

.4 Mix design to minimize shrinkage and to maximize water tightness.

.5 Mix proportions shall produce a mixture which will work readily into corners and angles of forms and around reinforcement. Mix proportions shall not permit segregation and shall not cause excessive water to collect on the surface.

.6 The addition of water to concrete at the site will not be permitted.

Part 3 Execution

3.1 PREPARATION

.1 Obtain Engineer's approval before placing concrete.

.1 Provide 48 hours minimum notice prior to placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete is permitted only after approval of equipment and mix.

.5 Ensure reinforcement and inserts are not disturbed during concrete placement.

.6 Prior to placing of concrete obtain Engineer's approval of proposed method for protection of concrete during placing and curing.

.7 Protect previous Work from staining.

.8 Clean and remove stains prior to application for concrete finishes.

.9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.10 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.

.1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.

.11 Do not place load upon new concrete until authorized by Engineer.

3.2 INSTALLATION/APPLICATION

.1 Do cast-in-place concrete work to CSA A23.1/A23.2.

.2 Compact concrete thoroughly and uniformly by means of tamping, hand tools, vibrators, or finishing machines to secure a dense, homogenous structure, close bond with reinforcement and smooth formed surfaces.

.3 Use internal vibrators wherever possible. External vibrators may be used where a satisfactory finish cannot be achieved with internal vibrators alone.

.4 Where required, vibration to be supplemented with hand spading adjacent to the forms.

.5 Maintain one spare, workable vibrator at all times while concrete is being placed.

.6 Place concrete continuously between pre-set construction and control joints.

.7 Honeycomb or embedded debris in concrete is not acceptable. Notify the Engineer upon discovery.

.8 Remove and replace defective concrete as directed by the Engineer.

.9 Sleeves and inserts:

.1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Engineer.

.2 Where approved by Engineer, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.

.3 Sleeves and openings greater than 100 x 100 mm not indicated must be reviewed by Engineer.

.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Engineer before placing of concrete.

.5 Confirm locations and sizes of sleeves and openings shown on drawings.

.6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.10 Anchor bolts:

.1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.

.2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Engineer.

.1 Formed holes: 100 mm minimum diameter.

.2 Drilled holes: to manufacturers' recommendations.

.3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.

.4 Set bolts and fill holes with epoxy grout.

.5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.

.11 Drainage holes and weep holes:

.1 Form weep holes and drainage holes in accordance with Section 03 11 00 - Concrete Formwork. If wood forms are used, remove them after concrete has set.

.2 Install weep hole tubes and drains as indicated.

.12 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.

.13 Finishing and curing:

.1 Finish concrete to CSA A23.1/A23.2.

.2 Use procedures as reviewed by Engineer or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.

.3 Use curing compounds compatible with applied finish on concrete surfaces.

.14 Finishing.

.1 Finish concrete in accordance with CAN/CSA-A23.1.

.2 Use procedures acceptable to Engineer or those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.

.3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.

.4 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.

.5 Immediately after the removal of forms, cut all ties back 25 mm from the concrete face. Fins and protrusions shall be rubbed down or ground off. Remove all honeycombed and other defective concrete down to sound concrete.

.6 Patch all honeycombed areas, defective areas, and tie holes. The area to be patched and an area at least 150 mm wide surrounding it to be dampened to prevent absorption of water from the patching mortar. Make a patching mixture of the same material and of approximately the same proportions as used for the concrete, except omit the coarse aggregate. Use a suitable epoxy bonding agent. The mortar to be thoroughly consolidated into place and struck-off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave it undisturbed for at least one hour before being finally finished. The patched area to be kept damp for at least seven days.

.7 Exposed interior concrete surfaces and all wall and beam surfaces within the water retaining portions of the structure are to be given a sack-rubbed finish.

.8 Unexposed exterior concrete surfaces are to have a plain, smooth form finish.

.9 Slab and floor surfaces to receive the finish specified below.

.1 Floated Finish

.1 After concrete has been placed, screeded, compacted, and levelled, do not work further until ready for floating. Begin floating when the water sheen has disappeared, or when the mix has stiffened sufficiently to permit the proper operation of a power-driven float.

.2 The surface shall then be compacted with power-driven floats. Use hand-floating with wood or cork-faced floats in locations inaccessible to the power-driven machine. Recheck the trueness of the surface at this stage with a 3000 mm straight-edge applied at not less than 2 different angles. Cut down high spots and fill low spots during this procedure. Then refloat the slab immediately to a uniform, smooth, granular texture.

.3 Finish tolerances for a floated finish to be true planes within 6 mm in 3000 mm as determined by a 3000 mm straight-edge placed anywhere on the slab in any direction.

.4 A floated finish is acceptable for surfaces intended to receive roofing and waterproofing membranes.

.10 Trowelled Finish:

.1 Use a trowelled finish for slabs, except where surfaces are intended to receive roofing and waterproofing membrane.

.2 After float finishing as specified above, the surface shall receive further finishing, first with a power trowel, and finally with hand trowels.

.3 The first trowelling after power floating shall be with a power trowel to produce a smooth surface which is relatively free from defects but which may still contain some trowel marks. Additional trowelling to be by hand after the surface has hardened sufficiently. Do the final trowelling when a ringing sound is produced as the trowel is moved over the surface. The surface to be thoroughly compacted by hand trowelling operations.

.4 Finish tolerances for a trowelled finish to be true planes. The surface shall be free of trowel marks and uniform in texture and appearance. Remove defects of sufficient magnitude to show through the floor covering by grinding.

.5 Ensure floor drains are set at the lowest points and finished surface to be a clean slope to drains as indicated on Plans.

.11 Broom Finish:

.1 All exterior slabs/sidewalks, not for equipment, to receive a broom finish.

3.3 SURFACE TOLERANCE

.1 Concrete tolerance in accordance with CSA A23.1/A23.2.

3.4 FIELD QUALITY CONTROL

.1 Site tests: conduct tests as follows and submit report:

.1 Concrete pours.

.2 Slump.

.3 Air content.

.4 Compressive strength at 7, 28 and 56 days.

.5 Air and concrete temperature.

.2 Inspection and testing of concrete and concrete materials carried out by testing laboratory hired by the Contractor for review to CSA A23.1/A23.2:

.1 .1 Ensure testing laboratory certified to CSA A283.

.3 An independent testing laboratory hired by the Contractor shall carry out inspection and testing of concrete according to CSA-A23.2. The cost of all tests will be borne by the Contractor. Owner will carry out any concrete testing for QA purpose only under the direction of the Engineer.

.4 Testing laboratory shall take 1 set of 5 test cylinders from each 100 m^3 of concrete placed but not less than 1 set from concrete placed on any 1 day, according to CSA-A23.2 as per Table below. The cost of concrete required for making the test cylinders and for air content, slump and temperature tests shall be borne by the Contractor. The Contractor shall also provide all necessary assistance for making of all test cylinders by Owner.

Number of Sample	7 days	14 days	28 days	56 days
35 MPa at 56 days	1	1	1	2

Concrete Class N				

.5 Testing laboratory by the Contractor shall make at least 1 slump test for each truck load of concrete.

.6 Testing laboratory by the Contractor shall carry out testing for entrained air content and concrete temperature at each truck load of concrete.

.7 Inspection or testing by the said laboratory shall not augment or replace the Contractor's quality control nor relieve him of his contractual responsibility.

.8 Owner will pay for costs of tests for QA or as specified.

.9 Submit all on-site testing results to Engineer review.

.10 Inspection or testing by Engineer not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.5 CURING

.1 Moist cure in accordance with CAN/CSA-23.1.

.2 Moist curing is deemed to be achieved only if one of the following methods are adopted:

.1 Continuous light sprinkling or ponding of clean water such as to saturate every exposed area of concrete subjected to the curing method.

.2 Providing an absorptive cover to the whole concrete surface subjected to the curing method, such as burlap, and keeping the cover continuously wet. Wet shall be defined as the extraction of free water from the absorptive cover by the action of hand-squeezing any quantity of the cover.

.3 Sealing the whole surface of the concrete subjected to the curing method with a continuous waterproof barrier approved by the Engineer.

.4 Covering the whole surface of the concrete subjected to the curing method with polyethylene sheet which is continuously sealed with waterproof tape at every joint and maintained in such condition that will ensure the air trapped between the concrete surface and the polyethylene sheet is continuously maintained at 100% humidity.

.5 Covering the whole surface with Hydradsorb perforated curing cover as supplied by Wallace Construction Specialties Ltd or equal authorized by Engineer.

.3 Submit method of curing to the Engineer for written authorization. Curing method shall state the concrete element to which it is applicable.

.4 Commence moist curing immediately following the final set and continue uninterrupted for the specified moist curing period.

.5 Moist cure normal Portland cement concrete or sulphate-resisting cement concrete for at least seven days.

.6 Moist cure high early-strength Portland cement concrete cured for at least three days.

.7 Moist cure concrete floor slabs, regardless of cement classification, for seven days.

.8 Cure concrete walls as follows:

.1 Continuously soak top of wall.

.2 Loosen forms as soon as possible without damaging concrete.

.3 Maintain continuous supply of water to top of wall to keep inside of forms wet.

.9 Do not use curing compounds except with written authorization by the Engineer. Do not use curing compounds on surfaces which are to receive concrete hardener, sealers, floor toppings, or bonded floor coverings such as paint or tile.

3.6 PROTECTION

.1 Protect all work, including soil below and adjacent to existing footings, against freezing, overheating, rapid drying, flooding and overloading.

.2 Provide weatherproof coverings, hoardings and heating equipment as required to permit continuous construction throughout any winter or inclement weather and to maintain working and curing conditions and to protect the existing facilities.

END OF SECTION

Part 1 General

1.1 DESCRIPTIONS

.1 This section refers to concrete finishing work.

1.2 REFERENCE STANDARDS

.1 CSA-A23.1 except where noted otherwise on the contract Drawings.

1.3 SUBMITTALS

.1 Product Data: Include material descriptions, chemical composition, physical properties, test data, and mixing and applications:

Part 2 Products

2.1 MATERIALS

.1 Concrete Materials: In accordance with Spec. 03 30 00 – Cast-In-Place Concrete.

.2 Sealer: Clear, liquid surface hardener and dust proofer, low V.O.C. content, Sikaguard Natural Look Clear Sealer by SIKA or approved equivalent.

.3 Curing compound: Clear Cure VOC J7WB, by Dayton or approved equivalent,

Part 3 Execution

3.1 FINISHING VERTICAL SURFACES

.1 General concrete finish:

.1 Cut all ties 25 mm back from the concrete face. Rub down or ground off fins and protrusions. Remove honeycomb and other defective concrete down to sound concrete.

.2 For watertight structures and for structures below ground level, fill all the tie-holes, honeycombed and defective areas with grout specified in Section 03 60 00 - Grouting Apply the grout in accordance with the manufacturer's recommendation and Specifications.

.3 For all other structures, patch all honeycombed areas, defective areas, and tie holes. Dampen the area to be patched and an area at least 150 mm wide surrounding it to prevent absorption of water from the patching mortar. Make a patching mixture of the same material and of approximately the same proportions as used for the concrete, except the coarse aggregate shall be omitted. Use a suitable epoxy bonding agent. Consolidate the mortar thoroughly into place and strike-off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave the patch undisturbed for at least 1 hr before applying the final finish. Keep the patched area damp for at least 7 days.

.2 Rubbed finish for water retaining structures:

.1 All exposed-to-view concrete surfaces, including the entire interior vertical surface in water retaining structures shall receive a sack-rubbed finish.

.2 Refer to CSA A23.1 for sack-rubbed finish.

.3 Sask-rubbed finish shall be undertaken as soon as the surfaces are accessible (forms stripped), while the rubbing mortar can be worked into the surface.

.3 Smooth-form finish:

.1 All exposed-to-view interior and exterior concrete surfaces not in contact with water shall receive a smooth-form finish.

.2 Refer to CSA A23.1 for smooth form finish.

.4 All external surfaces below and above ground, where waterproofing membrane is to be applied shall be prepared and finished to the texture and tolerance as per the requirements of the membrane supplier/applicator.

3.2 FINISHING HORIZONTAL SURFACES

.1 General slab finish:

.1 Roll or tamp concrete to force coarse aggregate into concrete mix and then screed. Float surface with power finishing machine and bring surface to true grade. Use wood or metal floats in locations inaccessible to the power-driven machine. Steel trowel to smooth and even surface. Produce smooth burnished surface to within 3 mm tolerance when measured in any direction using 3 m long straight edge.

.2 Sprinkling of dry cement or dry cement and sand mixture over concrete surfaces is not acceptable.

.3 Moist cure or apply curing compound if permitted in accordance with the manufacturer's instructions. After curing and when concrete is dry, seal joints.

.2 Trowelled finish:

.1 Provide trowelled finish for all concrete floors, concrete pads, and base slabs. Refer to CSA A23.1 for trowelling finish.

.2 After floating finishing as specified above, the surface shall receive further finishing, first with a power trowel, and finally with hand trowels. Trowel after power floating with a power trowel to produce a smooth surface which is relatively free from defects, but which may still contain some trowel marks. Additional trowellings shall be by hand after the surface has hardened sufficiently. Make the final trowelling when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly compacted by hand trowelling operations.

.3 Broomed finish:

.1 Unless noted otherwise, finish sidewalk, exterior concrete pad and stairs as per Clause 3.2.1 and 3.2.2, except that lightly broom the side perpendicular to traffic and edge with an edging tool in lieu of the second steel trowelling.

.2 Water cure the finishing surface.

3.3 SURFACE PREPARATION RECOMMENDATIONS FOR COATINGS ON ALL NEW CONCRETE

.1 Concrete surfaces shall be cleaned free of old existing coatings. New concrete to be cured a minimum of 28 days.

.2 Remove all debris from working surfaces.

.3 Remove all oils, greases, dirt and wax solutions from surface.

.4 Use suitable means to remove contaminants, heavy laitance, or curing compounds, which will interfere with proper adhesion. Special consideration must be given to oil or other foreign material, which may have been used to verify adequacy of preparation.

.5 Prime and use mortar as a leveling course for spalled or uneven surfaces and allow to cure 16 to 24 hrs at 20ºC before applying any coating.

.6 Repair all cracks with appropriate injection resin.

.7 Prepare concrete surface in accordance with manufacturer's instructions.

3.1 SURFACE SEALER APPLICATION

.1 Install concrete sealer on all new concrete floor without epoxy or other floor finish.

.2 Inspect surface preparation prior to application of sealer and report and deficiencies to Engineer.

.3 Do not commence application until all deficiencies have been corrected.

.4 Allow concrete surfaces to cure in accordance with sealer manufacturer’s recommendations.

.5 Apply sealer in two coats in accordance with manufacturer’s written application instructions at recommended rate.

.6 Protect floor areas receiving sealer from construction traffic during sealer application, between coats and after application until sealer has fully dried.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 All codes and standards governing the work shall be the current edition, in force at the time of tendering for this Contract:

.1 CSA A23.1, Concrete Materials and Methods of Concrete Construction.

.2 CSA A3000, Cementitious materials compendium.

.3 CSA A266.2, Chemical Admixtures for Concrete.

.2 Do grouting in accordance with the grout supplier's instructions, except where noted otherwise on the Contract Drawings.

1.2 SUBMITTALS

.1 Shop Drawings:

1. Product data of grouts including installation, application, and maintenance instructions.
2. Proposed method for keeping existing concrete surfaces wet prior to placing hydraulic cement grout.
3. Forming method for fluid grout placements.
4. Curing method for grout.

.2 Quality Control Submittals:

.1 Manufacturer’s Written Instructions:

.1 Adding fiber reinforcing to batching.

.2 Cement-water ratio of grout topping.

.3 Mixing of grout.

.2 Manufacturer’s proposed training schedule for grout work.

.3 Manufacturer’s Certificate of Compliance:

.1 Grout free from chlorides and other corrosion-causing chemicals.

.2 Non-shrink hydraulic cement grout properties of Categories II and III, verifying expansion at 3 or 14 days will not exceed the 28-day expansion and non-shrink properties are not based on gas or gypsum expansion.

.4 Manufacturer’s Certificate of Proper Installation.

.5 Statements of Qualification: Non-shrink grout manufacturer’s representative.

.6 Non-shrink Grout Manufacturer’s Representative: Authorized and trained representative of grout manufacturer. Minimum of one-year experience that has resulted in successful installation of grouts similar to those for this Project.

Part 2 Products

2.1 MATERIAL

.1 Water and fine aggregates to CSA A23.1.

.2 Cementious materials: CSA A3000, Type GU.

.3 Chemical admixtures: To CSA A266.2

.4 Non - Shrink grout: Pre-mixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents. Compressive strength to be minimum 40 MPa at 28 days:

.1 For pump, generator and other equipment bases:

.1 High performance epoxy grouting: Masterflow 649 by Masterbuilders.

.2 Or approved alternate.

.2 For general usage:

.1 MasterFlow 100 by BASF Master Builders Solutions.

.2 Or approved alternate.

.5 Bonding agent:

.1 Intralok by W. R. Meadows for normal usage.

.2 Or approved alternate.

.3 Apply bonding agent on existing concrete surface prior to grouting.

2.2 COMPATIBILITY

.1 Ensure that all materials used are compatible. Provide written proof of compatibility.

Part 3 Execution

3.1 WORKMANSHIP

.1 Obtain the Engineer’s approval of the type of grout to be used before placing.

.2 Handle, place, and cure non-shrink grout in accordance with Manufacturer's instructions. Request an inspection by the Engineer before placing grout.

3.2 PREPARATION

.1 Maintain surfaces and ambient air temperature of minimum 10°C for a minimum period of 24 hrs prior to, during, and 72 hrs after application.

.2 If grouting in exposed conditions, provide and maintain temporary weatherproof enclosures during inclement weather, during preparation, grouting and curing.

3.3 MIXING

.1 Mix grout dry and add water to bring mix to the correct consistency in a mechanical rotary mixer.

.2 Mix pre-mixed grout in accordance with the Manufacturer's instructions.

3.4 INSPECTION

.1 Notify the Engineer in writing 24 hrs before commencing grouting operations.

3.5 PLACING

.1 Roughen and clean contact surfaces and thoroughly wet with water prior to grouting.

.2 Prepare grout not earlier than 10 min before use and place in final position within 30 min.

.3 Apply bonding agent on the existing concrete surface prior to receiving new grout benching. The surface preparation of the existing concrete refers to Structural Drawings.

.4 Ram dry pack against suitable back-up blocker.

.5 Grout using procedures in accordance with the manufacturer's recommendations which will result in 100% contact over grouted area.

.6 Grout under base plates to be installed to assure full bearing. Remove all air pockets.

.7 Finish and tool grout exposed to view in a workmanlike manner, consistent with the finish of adjacent materials.

.8 Continuously moist cure at temperature above 5°C for 7 days and in accordance with the manufacturer's recommendations.

3.6 FIELD QUALITY CONTROL

.1 Contractor shall hire an independent testing laboratory to carry out flow cone and cube strength testing as per the instructions and recommendations by grout manufacturer’s representative.

.2 Submit a testing report to indicate whether the grout complies with the manufacturer’s requirements. Submit the testing report to Engineer for approval.

.3 Perform flow cone and bleed tests and make three 50 mm by 50 mm cubes for each cubic meter of each type of non-shrink grout used. Use restraining caps for cube.

.4 Tests must show that strength attained by non-shrink grout cubes is equal to or greater than minimum strength specified.

.5 Perform bleeding test to demonstrate grout will not bleed.

.6 Strength Test Failures: Remove and replace non-shrink grout work failing strength tests.

3.7 MANUFACTURER’S SERVICES

.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 type of grout.

.3 Establish location at site and schedule time for grout manufacturer’s demonstration and training session of proposed non-shrink grouts. Mix non-shrink grouts to required consistency, test, place, and cure on actual project, e.g., baseplates and tie holes to provide actual on-the-job training.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This Specification Section specifies the requirements for non-destructive investigations prior to drilling, cutting or coring concrete in existing concrete floors, walls, and ceilings.

.2 This Specification Section applies to, but is not limited to, work performed in the following areas:

.1 All existing concrete structures.

Part 2 Products

2.1 GPR AND X-RAY SCANNING

.1 Employ ground penetrating radar (GPR) scanning system optimized for scanning concrete and evaluating results directly on site.

.2 Employ X-Ray scanning system in the event that GPR is not able to determine the findings in existing concrete floors, walls and ceilings.

.3 Acceptable service providers:

.1 Grafscan.
.2 Canadian Cutting and Coring (Toronto) Limited.
.3 Global GPR Services.

Part 3 Execution

3.1 WORKMANSHIP

.1 When it is required to make new holes in existing concrete for piping, conduit, cables, or equipment, the Contractor shall, in all cases:

.1 Will not drill or cut any surface without prior approval of the Engineer.
.2 Determine the location, if any, of existing concealed rebar, conduit and cables, voids and slab thickness of the area to be drilled or cut and confirm routing/locations with the Engineer.
.3 Coordinate with the Engineer and employ integrated penetrating radar (GPR) scanning of the walls or slabs in the area of the proposed core at no additional cost to the Owner.
.4 In the event that GPR is not able to determine the findings in the existing concrete floors, walls and ceilings, X-Ray shall be applied at no additional cost to the Owner to do the further investigation with the approval and cooperation of the Engineer and the Owner.

.5 The Contractor shall be responsible for appropriate setup and boundary controls, signs, staging, etc. in the working area prior to conducting the structural GPR scan or X-Ray. The Contractor to notify the Engineer and the Owner in writing 48 hrs prior to commencing scanning work.

.6 Carefully perform all cutting in a neat and true fashion, with proper tools and equipment (no jack hammer drilling), to the approval of the Engineer.

.7 Patch surfaces, where required, to exactly match existing finishes using tradesmen, skilled in the particular trade or application worked on, to the approval of the Engineer.

.2 Any damage to existing services, exposed or concealed, caused as a result of the cutting and drilling work by the Contractor shall be repaired and/or replaced to the entire satisfaction of the parties concerned at the Contractor's expense.

.3 Where new pipe or conduits pass through existing construction, core drill the openings to an appropriate size with adequate clearances around the pipes, pipe insulation, or conduits as noted on the Contract Drawings as required for proper sealing.

3.2 CONCRETE INSPECTION METHODOLOGY

.1 Structural concrete inspection employing high frequency GPR or X – Ray suitable for locating rebar, conduit, cables and voids in concrete slabs up to 500 mm thick.

END OF SECTION

General

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittals Procedures.

.2 Section 01 61 00 - Common Product Requirements.

1.2 SCOPE OF WORK

.1 Contractor to provide a complete electric installation per the Drawings.

.2 The following scope includes the replacement of a single High Lift Pump with new power supply and Control Panel. Future works by others will include the replacement of the two remaining High Lift Pumps that will also eventually connect to the new Control Panel for power and controls.

.3 The new electric check valve will be wired to match the existing system but will be tied into the new pump control panel with new controls.

.4 This work program also includes the updates to the plant SCADA screens for the control of the electric check valves

.5 Provide 120V

1.3 GENERAL

.1 This Section covers items common to Division 26, Division 43 and Division 40. This section supplements requirements of the General Conditions and all of Division 01.

.2 The Contractor shall provide all material, labour, equipment, and transportation as necessary to complete the project in conformity with the Contract Documents. In general, this Work includes everything essential for a complete electrical system in operating order as shown or implied on the Drawings or hereinafter specified contract includes furnishing of labour, new material, equipment, and services necessary and reasonably implied and/or incidental to the complete installation of the electrical Work as shown on the plans and/or specified.

.3 The Drawings depicting electric Work are diagrammatic and show, in their approximate location, symbols representing electrical equipment and devices. The exact location of such equipment and devices shall be established in the field. Follow the Drawings as specified and complete the installation with appropriate conduit runs, offsets, junction boxes, etc., where required by local conditions, subject to approval and at no additional cost to the Owner.

.4 Unless specifically stated to the contrary, no measurement of an electrical drawing by scale shall be used as a dimension. Dimensions noted on the electrical Drawings are subject, in each case, to measurements of adjacent or previously completed Work and all such measurements necessary shall be taken before undertaking any Work dependent upon them.

.5 The Drawings do not show all conduits, cables, fastenings and supports. Provide conduit, cables, cable trays, fastenings and supports as required to implement the Drawings, process and instrumentation diagrams, schematics, riser diagrams, single line diagrams and all electrical documents.

.6 The electrical Drawings do not show every circuit that is to be installed under this Contract. Specific circuiting requirements for power circuits above the 208 V level are generally shown on the Drawings. Cables which are not shown on the cable schedules are to be sized based on the equipment circuit breaker and in accordance with the Ontario Electrical Code (OEC). Circuits are to be installed per the specific information included here. The Drawings provide the general locations for the equipment to be circuited.

.7 Branch circuit wiring for 120/208 V and 277 V equipment, lighting and receptacle circuits including conduits, and any structural floor or wall penetration requirements are generally not shown. The Contractor is responsible for determining the circuiting requirements for these circuits based on the branch circuit schedules, the locations of equipment and devices indicated on the Drawings, and the wiring requirements given in other sections of these Specifications and the OEC.

.8 Change location of electrical equipment if required by the construction or design at no extra cost or credit, providing distance does not exceed 3.0 m and information is given before the installation. Equipment location changes must be approved by the Consultant, on-site.

.9 In the event of a conflict between the Drawings and Specifications this Contractor shall base their bid on the greater quantity, cost, or quality of the item in question, unless such conflict is resolved by an addendum.

.10 Any Work which is obviously necessary or reasonably implied to complete the Work, even if not shown or specified, shall be carried out as if it were both shown and specified.

.11 If this Specification or the referenced Drawings conflict in any way with the requirements of the applicable codes and/or standards, the more rigorous requirement shall prevail. Contractor shall be responsible for the compliance with applicable codes and/or standards.

.12 Contractor shall provide all scaffolding, rigging, hoisting and services necessary for delivery, erection and installation of all equipment and apparatus required to be installed by the Contractor. All equipment shall be removed by the Contractor upon completion of the project.

.13 The project involves modifications to the existing site. The Drawings for the existing layout are to be considered as representative only, they may not necessarily indicate the true as-built conditions.

1.4 CODES AND STANDARDS

.1 All Work shall comply with the latest editions of the Building Code, Ontario Electrical Code, CSA Standards, Underwriters' Laboratories, all applicable Local Codes, and all other Authorities Having Jurisdiction. These codes and regulations constitute an integral part of the Specifications.

.2 Ontario Building Code of Canada (OBC) with amendments.

.3 National Fire Code of Canada (NFC) with amendments.

.4 National Energy Code of Canada for Building (NECB).

.5 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.6 CSA C22.2, Canadian Electrical Code, Part 2, General Requirements.

1.5 DEFINITIONS

.1 Unless further qualified, the following definitions apply:

.1 Wiring: Refers to any or all of conduits, cables, wires, conductors and associated fittings and hardware.

.2 Conductor: Refers to the current carrying portion of an insulated or non-insulated wire.

.3 Core/Wire (noun): Refers to a single, insulated conductor.

.4 Cable: Refers to an assembly of a single or multiple wires with shield, jacket, sheath, or armour.

.5 Field wiring: Refers to wiring outside a control panel or kiosk.

.6 Provide: Furnish, install and wire complete and ready for service.

.7 Furnish: Responsible for purchasing item and delivery to the jobsite.

.8 Install: Responsible for moving and mounting equipment to the final location then wire the equipment.

.9 Wire (verb): Responsible for final connections, ready for service.

.10 Expose: Expose to view in any room, corridor, or stairway.

.11 Demolish: Isolate, disconnect, remove equipment and appurtenances from site (subject to Consultant approval) and dispose, take out wiring, conduit, and any supports back to source.

.12 Wherever the term 'duct' appears, it applies equally to conduit.

1.6 PERMITS AND INSPECTIONS

.1 The Contractor shall be responsible to obtain and pay for all necessary permits and inspections as required or requested.

.2 Once the electrical Work has been completed and accepted by the Owner, the Contractor shall provide the Owner with certificates verifying that the Work has been completed in accordance with all Codes, Building Standards and all authorities having jurisdiction. All applicable permits shall be obtained prior to beginning of Work. The associated costs for prints, surveying, coordination with utility, utility pan review etc. shall be provided in the tender price.

.3 Submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.

.4 Contractor shall be responsible for any payment required for the purpose of review of Drawings and Specifications done by Electrical Inspection Department and Supply Authority.

.5 Consultant shall provide Drawings and Specifications required by Electrical Inspection Department and Supply Authority at no cost.

.6 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.

1.7 SITE VISIT

.1 The Contractor shall visit the site and examine all Drawings carefully to determine the extent of Work. Determine and include in the total price the total cost of labour and

material to disconnect, remove, relocate, blank off, reroute, or make safe all existing services and equipment as required. No Claim for extra cost for additional Work will be entertained for obvious considerations that may have been overlooked.

1.8 WORKMANSHIP STANDARDS AND MATERIALS

.1 All phases of the electrical installation shall be executed in a satisfactory manner and shall present a neat mechanical appearance when completed. Work not considered satisfactory to the Consultant shall be corrected at the Contractor's expense.

.2 All electrical Work to be carried out by qualified, licensed electricians or apprentices as per the Provincial Act with respect to vocational training and qualifications. Employees registered in a provincial apprentices' program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks and the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

.3 The Work of this division to be led by a certified master electrician who holds a valid master electrical contractor license as issued by the province that the Work is being constructed.

.4 Qualifications: Electrical Work to be carried out by qualified, licensed electricians [who hold valid Master Electrical Contractor license] or apprentices [in accordance with authorities having jurisdiction] [as per the conditions of [Provincial] [Territorial] Act respecting manpower vocational training and qualification].

.1 [Employees registered in provincial apprentices' program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks].

.2 [Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties].

1.9 WORK COORDINATION

.1 Co-ordinate with works by Other Contractors and other sections affecting or affected by the electrical Work.

.2 Where the intent of the Drawings and Specifications are not clear, the electrical contractor shall obtain the clarification of the Consultant, before proceeding with the Work. Ensure to use the proper channels of communication related to the Project.

.3 The Electrical Contractor shall give the Work their personal supervision, layout their own Work, do all necessary leveling and measuring, or employ.

.4 Prior to commencing Work, the electrical contractor shall review the Drawings and Specifications of other trades for conflicts within the electrical scope of Work, any such conflict shall be reported to the Consultant and a written ruling obtained before proceeding with the Work in question. Failure to report such conflicts will result in the Contractor's responsibility to make whatever adjustments are necessary.

.5 Contractor to supply and install lockable disconnect and cables for all HVAC motorized equipment in an accessible location within view of the equipment, as required. If disconnect is provided as part of the HVAC equipment, supply cable and install disconnect and cable as required. Refer to building mechanical Specifications and Drawings.

.6 Control wiring and conduit is specified in Division 26, except for conduit, wiring and connections below 50 V, which are related to control systems specified in Division 25 and shown on Mechanical Drawings.

.7 Electrical Subcontractor to coordinate with building mechanical Subcontractor to ensure all HVAC equipment works as intended in design, and as intended by manufacturer.

1.10 MECHANICAL PROTECTION

.1 Keep all conduit openings closed by means of caps or plugs to prevent the entrance of foreign matter. Protect all conduit, fixtures, equipment, etc. against dirty water, chemical or mechanical damage both before and after installation. Any such fixture, equipment, etc. damaged prior to final acceptance of the Work shall be restored to its original condition or replaced at the expense of the electrical Subcontractor.

.2 Equipment after installation shall be covered or otherwise suitably protected until the equipment is connected and operating.

1.11 EXCAVATION AND BACKFILL

.1 The electrical Subcontractor shall be responsible for all trenching required to complete the Contract. Coordinate all trenching routes with site civil Drawings, ensuring all required clearances are maintained.

.2 Ensure that route and depth of excavation for underground electrical duct banks, conduits or other equipment is as indicated. Provide protective materials around and over services and be present at all times during excavation and backfilling to supervise Work. Pay all associated costs.

.3 Machine tamp backfill in 150 mm layers to prevent future settling. Level all excess fill and leave the premises in a clean state. Return and correct any abnormal settling which appears later by adding additional fill material and properly backfilling to a uniform level.

.4 Where cable or wire runs through concrete walls encase in rigid conduit.

.5 Check in advance the location of all underground power, water, gas, or other services which may exist and excavate with care when in the proximity of the services. Be responsible for all damage caused during excavation and backfilling.

1.12 CONTRACT DOCUMENTS

.1 The Drawings for the Work of this Division are in part diagrammatic intended to convey the Scope of Work, general arrangement, approximate sizes and locations of the equipment and outlets.

.2 Report any discrepancies to the Consultant, prior to installation.

.3 Whenever differences occur between plans and diagrams/schematics, and between Specifications and Drawings, the maximum condition shall govern, and the Tender shall be based on whichever is the greater amount.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit Shop Drawings of major electrical equipment, as requested by Consultant,, unless otherwise noted.

.3 Each Shop Drawing shall be checked and stamped as being correct by the Contractor and the appropriate trade before submission to the Consultant, for review.

.4 Product data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for major equipment and include product characteristics, performance criteria, physical size, finish, and limitations.

.5 Submit WHMIS SDS in accordance with Divisions 01 and 02.

.6 Submit for review single line electrical diagrams under plexiglass and locate as indicated.

.1 Electrical distribution system in main electrical room.

.2 Electrical power generation and distribution systems in power plant rooms.

.7 Shop Drawings:

.1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.3 Indicate of Drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.4

.8 Certificates:

.1 Submit test results of installed electrical systems and instrumentation.

.2 Submit, upon completion of Work, load balance report as described in Part 3 - LOAD BALANCE.

.3 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Consultant,.

1.14 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 After completion of the Project, provide the following documents to the building owner and the Consultant,:

.1 One set of as-built Drawings in PDF format.

.2 Electrical inspection report.

.3 Written warranty.

.4 Provide set-up sheet for each programmed or configured device detailing parameter settings and ranges. Use manufacturer configuration sheets where available and submit in electronic format.

.5 Factory tests results for engineered equipment, generators, and controllers.

.3 Record Drawings:

.1 The Contractor shall keep a detailed up to date record of the following items:

.2 Feeder conduit routing, dimensions Drawings indicating all conduits in the slab, approximate junction box and branch conduit locations, actual circuit numbers, the equipment and devices are connected to.

.3 Project Record Drawings shall be maintained throughout the duration of the project. At the time of Project completion, a complete set of Drawings reflecting pertinent information shall be completed and turned over to the Consultant,.

.4 Contractor to provide electronic generated Drawings which will include all changes to the original tender Drawings and clearly marked as Project Record Drawings.

.4 Maintenance manual:

.1 Upon completion of the specified scope of Work, furnish an Electrical Systems Operations Manual, in a 3-post, hard-back binder. Each system and piece of equipment requiring adjustment or maintenance or whose operation is not apparent to unskilled users or as requested by the Owner shall each be covered by a separate section in the manual. Each section shall be separately tabbed and indexed. Provide 3 such copies of the operations manual to the Consultant for approval and distribution.

.2 Each electrical system shall be indexed as follows: Name of system or equipment complete with manufacturer's contact information, name and address of nearest service and parts Supplier/center, operations instructions, maintenance instructions, troubleshooting guide, list of replacement parts, wiring and connection schematics, assembly and parts diagrams, lighting.

.3 Lighting fixtures shall be indexes as follows: Fixture type designation as per drawing fixture schedule, name of manufacturer, catalogue number of fixture, catalogue number of lamps, catalogue number of ballasts (where applicable), name and contact information for local distributor and parts Supplier, illustration of fixture, list of areas where fixture is installed.

.5 Warranty:

.1 The Contractor shall provide the Owner with a written 1 year warranty, commencing on the date of acceptance. The warranty shall cover the complete electrical installation. The electrical contractor shall repair and/or replace any defects in materials or workmanship that occur during the Warranty Period at a time convenient to the Owner, and at no extra cost.

.6 Operation and maintenance:

.1 Data: Submit operation and maintenance data for VFD and network switch for incorporation into manual.

.2 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance Personnel.

.3 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.4 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.5 Post instructions where directed.

.6 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.7 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.15 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and acceptance requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and handling requirements:

.1 Store materials indoors, in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with a waste management plan.

.5 Fold up metal banding, flatten and place in designated area for recycling.

.6 Recycle materials per local facilities.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Operating voltages: To CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

2.2 MATERIALS AND EQUIPMENT

.1 Provide equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 All equipment to be certified by CSA or a Safety Codes Council Nationally Recognized Testing Laboratory (NRTL/C). Where such certified equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.

.3 All equipment shall be new unless otherwise noted.

.4 All items specified shall be the latest type or model produced by the manufacturer specified. If descriptive specification or model number is obsolete, substitute with current product with approval of Consultant.

.5 The design uses copper wiring unless explicitly stated otherwise

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Control wiring and conduit: In accordance with Division 26 and Division 40 except for conduit, wiring and connections below 50 V, which are related to control systems.

2.4 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Inspection Department and Consultant.

2.5 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates as follows:

.1 Nameplates: Lamacoid

.2 Sizes as follows:

Nameplate Sizes			
Size 1	10 × 50 mm	1 line	3 mm high letters
Size 2	12 × 70 mm	1 line	5 mm high letters
Size 3	12 × 70 mm	2 lines	3 mm high letters
Size 4	20 × 90 mm	1 line	8 mm high letters
Size 5	20 × 90 mm	2 lines	5 mm high letters
Size 6	25 × 100 mm	1 line	12 mm high letters
Size 7	25 × 100 mm	2 lines	6 mm high letters

.2 Labels: Embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Consultant prior to manufacture.

.4 Allow for minimum of 25 letters per nameplate.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. (_____) " if directed by Consultant.

.7 Disconnects, starters and contactors: Indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: Indicate system and voltage.

.9 Transformers: Indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

.1 All Power, instrumentation and control wires:

.1 Shall be provided with indelible permanent wire tags at each end of the wire.

.2 Shall use polyester or polyolefin heat-shrinkable sleeves.

.3 Marking shall be abrasion, ozone, ultraviolet, and solvent resistant.

.4 Numbering shall match control wiring diagrams.

.5 Numbering shall match on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: To CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

.1 Conductors to be labelled at each end by slip-on plastic tags or by machine-printed heat-shrink labels. Use the conductor designations shown on the wiring Drawings. Seal all conductor labels with clear heat-shrink covers.

.2 Tag where a conduit or cable enters a panel or piece of equipment.

.3 WRITE-ON LABELS ARE NOT ACCEPTABLE.

.4 Cable tags to be attached with 2 black UV resistant tie-wraps.

.5 Where installation is a food preparation establishment- tie-wraps are to be of the type traceable in a metal detector. Colour code conduits, boxes, and metallic sheathed cables.

.6 Colour code conduits, boxes, and metallic sheathed cables.

.7 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.8 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 FINISHES

.1 Coordinate painting requirements with Specifications.

.2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least 2 coats of finish enamel:

.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1.

.2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of conditions: Verify that conditions of substrate previously installed under other sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed Consultant.

3.2 CARE, OPERATION AND START-UP

.1 Instruct operating Personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service Engineer to supervise start-up of installation, check, adjust, balance, and calibrate components and instruct operating Personnel.

.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.

3.3 INSTALLATION

.1 Do complete installation in accordance with OEC, except where specified otherwise.

.2 Do overhead and underground systems in accordance with CAN/CSA-C22.3, No.1, except where specified otherwise.

.3 Workmanship shall be in accordance with well established practice and standards accepted by Contract Administrator.

.4 The Contract Administrator has the right to reject any item of Work that does not conform to the contract documents and accepted standards of performance, quietness of operations, finish, and appearance.

.5 Secure equipment to masonry, tile, and plaster surfaces with suitable structural anchors. (Hilti or equivalent).

.6 Secure equipment to poured concrete with expandable inserts.

.7 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.8 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.9 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.10 Fasten exposed conduit or cables to building construction or support system using straps.

.11 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.

.12 Two-hole steel straps for conduits and cables larger than 50 mm.

.13 Beam clamps to secure conduit to exposed steel work.

.14 Suspended support systems (when cable tray is not indicated):

.1 Support cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.

.15 For surface mounting of 2 or more conduits use channels at 1.5 m oc spacing.

.16 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.17 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.18 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.19 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

.20 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.4 CONDUIT AND CABLE INSTALLATION

.1 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation. Fireproof the penetration after installation.

.2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

.3 Any mechanically assisted cable pulls require a tension monitoring log to be submitted to the Consultant.

3.5 FIRE PROOFING OF CABLE AND OTHER ELECTRICAL OPENINGS

.1 Where penetrations are made through roof slabs or walls between fire zones, fire-stopping must be applied.

.2 Only use proprietary fire-stopping system(s) tested and approved for fire proofing of electrical cable penetrations in roof slabs or walls between fire zones. Fire rating to be selected in accordance with the Building Code.

.3 Seal modules shall provide bonding to Teck armouring and may be used for high density cable penetration of panels and junction boxes.

.4 Fireproof seals for more openings with than 1cable or conduit shall be re-useable, bricks, sleeves or equivalent.

.5 Install per manufacturer’s instructions.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

.2 Submit time-current curves for fuses, breakers and protective devices for equipment supplied under this Contract.

.3 Submit operation and maintenance manuals for protective relays, motor protection relays, overload devices supplied under this Contract.

.4 Consultant to provide coordination study after all Shop Drawings have been submitted.

.5 Contractor to be responsible for producing a coordination study, short circuit, and arc-flash studies.

.6 Arc-Flash labels shall be provided and meet OEC requirements.

3.7 FIELD QUALITY CONTROL

.1 Conduct following tests in accordance with Section 26 05 01:

.1 Power systems, including phasing, voltage, grounding, and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable.

.4 Communication systems.

.5 Insulation resistance testing:

.1 Megger circuits, feeders, and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders, and equipment with a 1,000 V instrument.

.3 Megger 4,160 V circuits, feeders, and equipment with a 5,000 V instrument.

.4 Check resistance to ground before energizing.

.2 Provide instruments, meters, equipment, and Personnel required to conduct tests during and at conclusion of project.

.3 Should it be found by the Consultant that any equipment or any portion of the electrical system installed under this Contract fails to comply with the Contract Documents with respect to quality of workmanship or materials, such shall be replaced by the Contractor and all other Work disturbed by correction of defects or imperfections shall also be corrected at the Contractor's expense.

.4 The operation of the equipment and electrical systems does not constitute an acceptance of the Work by the Owner. The final review is to be made after the Contractor has adjusted the equipment and demonstrated that it fulfills the requirements of the Drawings and the Specifications.

.5 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction. Demonstrate that all Work is complete and in ideal operating condition, with raceway and conduit system properly grounded, all wiring free from grounds, shorts, and that the entire installation is free from any physical defects. In the presence of the Consultant, the Contractor shall demonstrate the proper operation of all miscellaneous systems.

.6 Manufacturer's field services:

.1 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.

3.8 HARMONICS

.1 Prior to installation, a harmonic summary report shall be produced by the Contractor to 'base line' the facility prior to any Work.

.2 IEEE 519 harmonic summary report to be created. Report to include:

.1 Total THD per phase.

.2 Harmonic spectral represented as a graphical frequency plot from the fundamental frequency up to the 20^{th} harmonic of the fundamental.

.3 Upon completion of project, a harmonic summary report shall be produced to 'as-built' the facility as part of commissioning.

3.9 SINGLE LINE ELECTRICAL DIAGRAMS

.1 Provide single line electrical diagrams under plexiglass as follows:

.1 Electrical distribution system: Locate in main Electrical Room.

.2 Drawings: Match the Drawings provided 600 × 900 mm minimum size.

3.10 OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance Personnel:

.1 Service entrance, distribution, and metering.

.2 Variable frequency drives.

.3 Motor controls.

.4 Instrumentation and control equipment.

.2 Operating instructions to include the following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

3.11 CLEANING

.1 Progress Cleaning: Clean in accordance with Specifications.

.2 During the progress of the Work, the Contractor shall remove from the building site any rubbish, dirt, and other debris caused by performance of the Work.

.3 Leave Work area clean at the end of each day.

.4 Final Cleaning: Upon completion**,** remove surplus materials, rubbish, tools, and equipment in accordance with Specifications.

.5 Clean and touch up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

.6 The Contractor shall clean all exposed ironwork, the interior and exterior of cabinets and pull boxes, etc., and remove all rubbish and debris resulting from the Work.

.7 Clean and prime exposed non-galvanized hangers, racks**,** and fastenings to prevent rusting.

.8 On completion of Work, remove debris from the site, repair any damage done to the Work of others and leave the installation in a clean and neat condition to the satisfaction of the Consultant.

.9 In the event that a final inspection cannot be completed because of an excessive deficiency list or that the plant cannot be placed into continuous operation because of deficient or defective Work, the Contractor may be charged by the Owner for the additional engineering services, re-inspections, and later start-up assistance.

3.12 CONDUIT AND CABLE INTERCONNECTION SCHEDULE

.1 The conduit and cable interconnection schedule are provided as a guide only. The schedule represents general information on cable description, type and size, and reference Drawings. The schedule and Drawings may not include all the cables to complete the Work.

.2 Any cables shown on drawing and not included in the cable schedule shall be provided as part of the Work. Size cables to suit the loads being supplied.

.3 Branch circuit wiring to 120/208 V equipment and grounding is generally not included in cable schedules.

.4 Schedules to be used in conjunction with Division 26, single line diagrams, P&IDs, instrument index, motor control schematics, instrument loop diagrams, location Drawings and cable tray layouts.

.5 Cables labelled in cable trays are shown for information only; Contractor to verify cable schedules and layouts prior to installing cables in cable trays.

.6 Cables for future loads are not part of this Contract, they are shown to allow cable space in cable tray system.

.7 The ampacity of cables in tray is based on:

.1 One cable diameter spacing and 1 layer - 100% of CEC Table 2.

.2 Random fill multi-layers - 50% of CEC Table 2.

.8 Provide cables and interconnect packaged manufacturers supplied equipment in accordance with Suppliers' requirements, if different from the cable schedule or Drawings.

3.13 AREA CLASSIFICATION

.1 All areas identified in Section 22 of the Canadian Electrical Code shall follow the installation requirements of those sections.

.2 All process areas are Category 1.

.3 In areas subject to dripping or splashing water or sprinklers:

.1 Provide drip shields and sprinkler shields for other equipment where it is a readily available option, and it will not interfere with sprinkler function, equipment function, or equipment enclosure performance.

.2 Drip shields and sprinkler shields shall be resistant to corrosion by suitable selection of material (e.g., stainless steel, FRP) or finish (e.g., factory primed and painted).

.3 For ventilated applications, NEMA 1 gasketed enclosures are acceptable alternatives as approved Consultant.

.4 In electrical rooms and similar areas: Control panels use NEMA 12 gasketed, non-ventilated construction. Non-ventilated, weatherproof, or equivalent acceptable where NEMA 12 gasketed, non-ventilated not available. Ventilated acceptable where there is no practicable alternative (such as MCCs). Areas above ceilings shall generally be considered the same as adjacent areas they communicate with.

.5 Materials and methods outdoors shall be weatherproof, suitable for the location and temperatures, and shall be marked as UV resistant:

.1 Provide wiring that is CSA listed for installation in wet locations, where exposed, installed in buried conduit, or installed in conduit in slab. All such wiring shall meet these requirements, including power, control, instrumentation, communication, and other wiring.

.2 Areas above ceilings shall generally be considered the same as the harshest adjacent area they communicate with.

3.14 SEISMIC RATED ANCHORS AND RESTRAINTS

.1 The project is classified as a post disaster building.

.2 All fixing anchors for equipment, luminaires, control panels and cable support structures including cable tray shall rigidly attached the structure and not suspended.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Description:

.1 This Specification covers the field inspection, testing, checking out and adjustments, if necessary, of all electrical equipment and materials in the completed facility.

.2 All Start-up and Commissioning to conform to the requirements of Section 01 75 01 1 - Pre-Start-Up, Start-Up and Commissioning for Pre-Start-Up, Start-up, Commissioning, Equipment Installation Certification Forms and Pre-Commissioning Certification Forms.

.2 General:

.1 Workmanship, methods, inspections, and materials used in erection and installation of the subject equipment to conform with accepted engineering practices, IEEE Standards, the Canadian Electrical Code, Provincial requirements, and the Specifications for electrical work.

.2 Perform all wire checks, including factory wiring, setting up all test equipment and any other preliminary work in preparation for the electrical acceptance tests. Inspect all equipment to make sure it has been installed in accordance with the manufacturer's recommendations.

.3 Each acceptance test shall be witnessed by the authorized representative for the Consultant,, unless otherwise advised.

.4 Schedule all testing with Consultant’s, approval and no testing shall be performed without approval.

.5 The testing shall be performed by and under the immediate supervision of the Contractor:

.1 Notify the Consultant,, in writing, at least 72 hrs prior to test establishing the time the test is to be performed.

.6 Field test (as outlined in the following paragraphs) all wire, cable and electrical equipment to assure proper installation, settling, connections, and functioning in accordance with this project's Drawings and Specifications, and manufacturer's recommendations and perform any additional tests deemed necessary by Consultant, to determine that equipment, materials, and systems meet the requirements of the project.

.7 Final acceptance will not only depend on equipment dependability, as determined by the subject tests; but will depend on complete operational tests on all equipment to show that the equipment will perform the functions for which it was designed and meet the requirements of the project and Specifications.

.8 Manufacturers shall be notified and shall be permitted to witness high voltage or other tests performed on their equipment if they so request.

.9 No equipment is to be energized without the approval of a designated representative of Consultant,.

.10 The following precautions shall be observed prior to energizing any equipment:

.1 Make certain that all construction dirt and debris, conducting material, wire trimmings, and unused or dropped hardware have been removed.

.2 All electrical equipment shall be vacuum cleaned to dust free condensation (equipment shall be dried out, if necessary).

.3 The enclosures, door(s), etc., shall then be visually inspected for protective integrity.

.4 Inspect and check all bolted bus connection and bus bracing for proper assembly.

.5 Operate the equipment manually and visually inspect the same for proper clearances of all moving items also making certain that proper lubrication is in evidence.

.11 Furnish all required testing equipment and safety devices including, but not limited to the following items:

.1 500 V, 1,000 V, 5,000 VDC meggers, 0-10+ giga Ohm scale.

.2 Portable telephone sets and 2-way radios, if required.

.3 150-1,000 VAC voltmeters, 0-500 A AC ammeters 1.5% accuracy.

.4 Volt-Ohm-Milli-ammeters, Simpson or as approved.

.5 Micro-ohm meter 10 A output.

.6 Phase rotation meters, 60 Hz.

.7 D.C. voltmeter 0-1,000 VDC. DC ammeter to 10 A.

.8 Rubber gloves, rubber mats, goggles, insulated tools, and any other equipment necessary to ensure safe working condition.

.9 Signals and danger signs.

.10 Miscellaneous cable, switches, receptacles, plugs, etc., as required.

1.2 SAFETY

.1 The purpose of electrical equipment testing, and checking is to determine whether the device will work properly as intended for the specific job to which it is applied. The field testing of apparatus shall, as much as possible, duplicate actual operating conditions, e.g., control circuits energized. In many instances, this requires that the apparatus be in actual use. For safety, the testing of live equipment at power voltage shall be avoided whenever possible.

.2 If temporary circuits must be maintained, accidental contact with other circuits and live parts on adjacent apparatus must be prevented. If at all possible, power to adjacent apparatus shall be disconnected prior to testing.

.3 Equipment under test shall be isolated from remote control or feedback circuits to prevent accidental energization by others. If power must be maintained as part of the test, personnel shall be protected against electrical shock by rubber floor mats, rubber gloves, goggles, approved non-conducting safety hats, and insulated tools.

.4 Bus runs that have been disconnected for test purposes shall be grounded to prevent feedback of test voltages. If these conductors cannot be grounded, the test area shall be roped off or otherwise protected from the accidental approach of unauthorized and unnecessary personnel while test is in progress.

.5 Capacitive circuits and any device capable of storing electrical energy received from test voltages are a significant hazard. They shall be grounded during the test, or if they are necessary and included in the circuitry, they shall be grounded after each application of test voltages.

1.3 PHASING AND SYNCHRONIZING

.1 All power cable and bus duct circuits shall be checked to verify that connections, regarding phasing, are in accordance with the Drawings.

.2 All power cable circuits shall be checked to verify that all circuits that can be energized from 2 or more sources are in phase.

1.4 WIRE AND CABLE

.1 All cable connections must pass visual inspection for workmanship and conformance with standard practice.

.2 All wire and cable shall be tested for continuity.

.3 All cables for 600 VAC circuits shall be megger tested with a 1,000 VDC megger for 1 min. The insulation resistance level shall not be less than 100 MΩ, with the exception of circuit directly connected to existing equipment shall not be less than 5 MΩ:

.1 During insulation tests all switchboards, panelboards, fuse holders, switches, and overcurrent devices to be in place (except devices with sensitive electronic components recommended by manufacturer not to be megger tested).

.2 Motors and transformers shall not be connected during megger tests.

.4 Each phase shall be tested between conductor and ground and between phases.

.5 For 600 V cables, the cable megger test shall be held until 3 equal readings, each 1 min apart, are obtained.

.6 Lighting circuits and all 120 V power services shall be tested only during construction for continuity and identification and shall pass operational tests to see that the circuits perform all functions for which they are designed.

.7 The 120 VAC to 4,160 VAC and control cable shall be checked by megger tests similar to those described for 600 V wire and cable. Control wiring shall be checked for proper connection in accordance with interconnection diagrams or tables and for tightness of terminal contacts and continuity through each "run" of control circuiting.

.8 Complete and accurate records of all cable tests and inspection shall be made.

1.5 MOTORS

.1 All motors large and small shall pass a minimum 100 MΩ reading at room temperature. Any machine not passing this test shall be dried and retested until it either passes or is found unsatisfactory.

.2 Prior to testing, all rotating equipment shall be inspected for cleanliness, damage, moisture, proper lubrication, oil leaks and phase identification. Proper rotation shall be checked.

.3 The test shall include the connected motor cables. Where magnetic contactors are used, contactor shall be blocked in closed position so that the section of conductor between circuit breaker and magnetic contactor is included in test. Control circuit conductors shall be isolated.

.4 Megger tests shall be applied between all phases tied together and ground. Megger tests shall be taken with motor winding temperatures at room temperature.

.5 Megger test shall be held for one minute once the megger reading stabilises. Repeat tests to be performed at Consultant's, discretion.

.6 Final acceptance of motors cannot be made until the equipment is energized during operational tests. Operational tests shall prove proper rotation and lubrication. The motor shall not have excessive vibration or unusual heating.

1.6 BEARING CURRENT MEASUREMENT

.1 Shaft voltage:

.1 Measure the discharges per minute, using a SKF discharge wand.

.2 Measure the shaft discharges at start-up, commissioning, and after the 30-days run in.

.3 Provide a report to the Consultant, after the 30 days run in period.

.4 Immediately report greater than 5 discharges per min to the Consultant,.

1.7 CONTROLS

.1 Electrical controls, circuits and systems shall be tested by trial operation of control equipment after all wiring is completed to see that each interlock and control function operates in accordance with the Drawings and Specifications, and the description of operation for the equipment. Where field conditions prevent actual equipment functioning during testing, the Contractor shall simulate the intended operating condition in the associated control circuits.

.2 Locate the cause of any malfunction, within the contractor's scope of responsibility, and make the necessary wiring and/or equipment changes or corrections to obtain the particular systems intended operation as defined by the Drawings. Costs of these necessary changes are included in the base bid. Such changes shall be included in the test report.

.3 Control panels shall be operated through all design functions. This shall include remote operation of all equipment and actuation of alarms and indicating devices according to design requirements.

.4 Complete operational tests shall be given to all relays and control devices to show that the equipment performs all design functions and meets design and procurement Specifications.

1.8 GROUNDING

.1 Provide resistance readings of the ground grid and the bonding at the sample points around the installations (all motors, receptacles, lights, etc.).

.2 Loop Impedance: Test to demonstrate compliance to CEC 22.1 - Appendix B, 10-500:

.1 Use a Fluke 1653B Installation Tester W/Autotest.

.2 Use 2403368 NEMA 5-15 Plug three 4 mm Banana.

.3 Perform ground continuity and resistance tests meeting the approval of Consultant, and local authority having jurisdiction over installation:

.1 Use a Fluke 1653B Installation Tester W/Autotest.

.4 Earth Impedance use Geo-Earth-Stake A604510350 Ground/Earth Earth Stake.

.5 Perform ground impedance tests before energizing electrical system.

.6 Perform loop impedance tests with electrical system energized.

.7 Disconnect ground fault indicator during tests.

1.9 MISCELLANEOUS

.1 All other breakers, switches, and contactors shall be given complete operational tests to determine that all design functions are satisfactorily performed.

.2 All switches (control, instrument, disconnect, safety, etc.) shall be inspected and tested as to cleanliness and operation. Contacts so requiring, shall be cleaned before operation.

.3 Switches shall be checked for correct sequence of operation.

.4 Fuses shall be inspected for correct rating.

.5 Coordinate all testing of instruments for those devices.

1.10 CIRCUIT BREAKERS - LOW VOLTAGE

.1 All field tests for low voltage circuit breakers as herein outlined shall be completed by the electrical Subcontractor.

.2 Visual inspection:

.1 Circuit breaker shall be checked for proper mounting, conductor size and feeder designation.

.2 Operate circuit breaker to ensure smooth operation.

.3 Inspect case for cracks or other defects.

.4 Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.

.3 Electrical test:

.1 Measure contact resistance.

.2 Insulation resistance shall be determined phase to phase and phase to ground. Test voltage shall be 1,000 VDC.

.4 Test results:

.1 Contact resistance shall be compared to adjacent poles and similar breaker. Deviations of more than 50% shall be investigated and corrected.

.2 Insulation resistance shall not be less than 50 MΩ.

1.11 SURGE PROTECTIVE DEVICES

.1 Visual and mechanical inspection:

.1 Inspect lightning surge arresters for physical damage, such as chipped or fractured porcelain.

.2 Verify proper mounting and clearances.

.3 Check external bolted joints shall be checked for tightness by calibrated torque wrench method.

.4 Check ground leads on each device for attachment to a ground bus or ground electrode.

.5 Check exhaust ports on expulsion type arresters for any obstructions.

.2 Electrical tests:

.1 A ground continuity test shall be performed to the ground grid system.

.2 Varistor surge arresters: Perform tests as recommended by the manufacturer.

1.12 DC HIGH POTENTIAL TEST RESULTS

.1 Step voltage slope shall be reasonably linear.

.2 Absorption slope shall be flat or negative. In no case shall slope exhibit positive characteristics.

.3 Shield continuity test shall exhibit circuit continuity of shield and conductor.

.1 system is grounded upstream of sensor.

.2 Ground strap systems are grounded through sensing device.

.3 Ground connection is made ahead of neutral disconnect link.

.4 Inspect control power transformer to ensure adequate capacity for system.

.5 Proper operation and test sequence shall be recorded.

.6 Zero sequence system shall be inspected for symmetrical alignment of core balance transformers about current carrying conductors.

.7 Ground fault device circuit nameplate identification shall be verified by actuation observation.

.8 Pickup and time delay settings shall be set in accordance with settings developed through verification with Consultant.

.4 Electrical tests:

.1 System neutral insulation resistance shall be measured to ensure no shunt ground paths exist, neutral ground disconnect link shall be removed, neutral insulation resistance measured, and link replaced.

.5 Test parameters:

.1 System neutral insulation shall be minimum of 100 ohms preferably 1 megaohm or larger.

Part 2 Products

Not Used.

Part 3 Execution

3.1 GENERAL FIELD-TESTING REQUIREMENTS

.1 The following testing requirements shall be completed by the electrical Subcontractor:

.1 Test Work and equipment installed to ensure its proper and safe operation in accordance with intent of Drawings and Specifications.

.2 Check interlocking and automatic control sequences and test operation of safety and protective devices.

.3 Correct defects.

.4 Cooperate with electrical utility, suppliers', and manufacturers' representatives in order to achieve proper and intended operation of equipment.

.5 Test, adjust, and record operating voltages at each system level before energizing branch circuits.

.6 Transformer taps must be adjusted to obtain as near as possible nominal system voltage.

.7 Where transformer is under utility jurisdiction, obtain services of utility to correct voltage.

.8 Replace devices and equipment damaged due to failure to comply with this requirement.

3.2 TEST REPORTS

.1 During each of the aforementioned tests, maintain a comprehensive set (quantity of duplicates to be determined Consultant of test reports defining the specific condition in which the apparatus is left, after it has been given approval for use in its intended service.

.2 The completed reports shall become the property of the Consultant,.

.3 A checklist type report for each individual item of major electrical equipment should be headed with, but not limited to, the following identification data defining:

.1 Equipment Name.

.2 Item Tag Number.

.3 Manufacturer.

.4 Type of Class.
.5 Application.
.6 Plant Location.
.7 Voltage Rating.
.8 Date of Test.
.9 Ambient Conditions.
.10 Testers Signature.

.4 Among the specific requirements of testing to determine the equipment's operational condition relative to that particular apparatus, all items shall be visually inspected and evaluated on the report as to its general condition both exterior and interior.

.5 Unless otherwise directed by Consultant, the forms used for testing shall be those that are available by the particular equipment's manufacturer and as per Division 01.

3.3 EQUIPMENT TO BE TESTED

.1 Building wire and cable.

.2 Grounding.

.3 Motors.

.4 Feeders.

.5 Motor controllers and control centers.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This section includes requirements for selective demolition and removal of electrical safety and security, communications components including removal of conduit, junction boxes, and panels to source (home run removal) and incidentals required to complete Work described in this section.

1.2 DEFINITIONS

.1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.

.2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.

.3 Existing to remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.

1.3 SITE CONDITIONS

.1 Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.

.2 Discovery of hazardous substances:

.1 It is not expected that hazardous substances will be encountered in the Work.

.2 Immediately notify Consultant, if Materials suspected of containing hazardous substances are encountered.

1.4 SALVAGE AND DEBRIS

.1 Owner reserves the first right of refusal to removed equipment. They may retain old equipment as spares for the remaining equipment.

.2 Demolished items become Contractor’s property and will be removed from Project Site; except for items indicated as being reused, salvaged, or otherwise indicated to remain the Owner’s property.

.3 Carefully remove materials and items designated for salvage and store them in a manner to prevent damage or devaluation of.

.4 Leave main electrical distribution panel in place; panel can be used for temporary construction power for this and subsequent contracts in accordance with Specifications; coordinate temporary power connections with Consultant,.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Materials and equipment for patching and extending Work: As specified in individual sections.

Part 3 Execution

3.1 EXAMINATION

.1 Verify field measurements and circuiting arrangements are as shown on Drawings.

.2 Verify that abandoned wiring and equipment serve only abandoned facilities.

.3 Demolition Drawings are based on field observation and existing record documents. Report discrepancies to Consultant, before disturbing existing installation.

.4 All Materials identified to be salvaged or reused shall be inspected by the Contractor prior to removal. The Contractor shall provide a list of damaged equipment to the Consultant,.

.5 Beginning of demolition means the Contractor accepts existing conditions.

3.2 PREPARATION

.1 Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

.2 Coordinate utility service outages with the utility company.

.3 Provide temporary wiring and connections to maintain existing systems in service during construction. When Work must be performed on energized equipment or circuits, use Personnel experienced in such operations.

.4 Existing electrical service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Consultant, at least 5 Working Days before partially or completely disabling system. Minimize outage duration.

.5 Existing fire alarm system: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Consultant, and local fire servant at least 5 Working Days before partially or completely disabling system. Minimize outage duration.

.6 Protection of building occupants: Schedule Work to minimize interference with occupants. Prevent debris from entering drains, protection other systems not to be demolished.

.7 Provide barriers to allow safe access and egress to the Project Site.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

.1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.

.2 Remove existing electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.

.3 Perform demolition Work in a neat and workmanlike manner:

.1 Remove tools or equipment after completion of Work, and leave site clean and ready for subsequent renovation Work.

.2 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as “SPARE”.

.3 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.

.4 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.

.5 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.

.6 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

.7 Remove abandoned wiring to source of supply.

.8 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets, which are not removed.

.9 Maintain access to existing electrical installations, which remain active. Modify installation or provide access panel as appropriate.

.10 Extend existing installations using materials and methods as specified.

.11 Where conduits penetrate below grade walls, they shall be removed as far as possible, sealed and/or capped to maintain the water integrity of the building envelope.

3.4 CLOSEOUT

.1 Update Drawings with Work completed.

.2 Arrange for legal disposal and remove materials to accredited provincial landfill and recycling facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Division 01.

.2 Division 26.

1.2 REFERENCE STANDARDS

.1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

.3 CAN/CSA-C22.2 No. 239.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: Stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: Size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

.3 Copper conductors: size as indicated, with thermoplastic insulation type TWU or TWH, rated at 600 V.

2.2 TECK 90 CABLE

.1 Cable to CAN/CSA-C22.2 No. 131.

.2 Conductors:

- .1 Grounding conductor: Copper.
- .2 Circuit conductors: Copper, size as indicated.

.3 Insulation:

- .1 Ethylene propylene rubber EP.
- .2 Cross-linked polyethylene XLPE.
- .3 Rating: 1,000 V.

.4 Inner jacket: Polyvinyl chloride material.

.5 Armour: Aluminum.

.6 Overall covering: Thermoplastic polyvinyl chloride.

.7 Fastenings:

- .1 One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for 2 or more cables at 3 mm centers.
- .3 Threaded rods: 6 mm dia. to support suspended channels.
- .4 316 SS or electrogalvanized steel Cobra P-style clamps for Unistrut.

.8 Connectors:

.1 Watertight approved for TECK cable.

.2 Explosion-proof approved for TECK cable in hazardous areas as indicated on Drawings.

2.3 TECK CABLE – VFD SYSTEMS

.1 Requirements to match Article 2.2.

.2 Cable voltage rating to be 1 class higher that motor voltage rating:

.1 575 V motors to use 1,000 V cable.

2.4 FITTINGS

.1 In wet, damp locations, indoors or outdoors, StarTeck compression fittings or equivalent shall be used.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Division 26.

.2 Perform tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Conductor length for parallel feeders to be identical.

.2 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.3 Wiring in walls: Typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.4 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e., common neutrals not permitted.

.5 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

.6 Provide a drip loop for all cables entering exterior walls or enclosures in wet locations, outdoors or Category 1 or 2. Arranged penetrations so that they are not above other equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA Group:

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 65, Wire Connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

1.2 DELIVERY, STORAGE AND HANDLING

.1 Delivery, storage, and handling in accordance with Section 01 61 00 – Common Product Requirements and Division 26.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

.1 Copper long barrel or short barrel compression connectors to CSA C22.2 No. 65, as required sized for conductors.

.2 Contact aid for aluminum cables where applicable.

.3 Submersible motor cable connectors to be rated for wet environment.

Part 3 Execution

3.1 INSTALLATION

.1 Install terminations and splices in accordance with manufacturer's instructions.

.2 Bond and ground as required to CSA C22.2 No. 41.

.3 Cable termination to be insulation tested to the test voltage of the cable being terminated.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE):

.1 ANSI/IEEE 837, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

.2 CSA C22.2 - Canadian Electrical Code, Part I, Safety Standard for Electrical installations.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Provide test reports indicating overall resistance to ground and bonding resistance for the primary feeders.

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Grounding conductors: Bare stranded copper, soft annealed, size as indicated.

.3 Insulated grounding conductors: Green.

.4 Ground bus: Copper, size as indicated, complete with insulated supports, fastenings, connectors.

.5 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 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

.6 Oxide inhibitor joint sealant shall be used for all copper crimp connections after the compression:

.1 De-Ox oxide inhibitor or equivalent.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.8 Connect building structural steel and metal siding to ground by welding copper to steel.

.9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.11 Ground secondary service pedestals.

.12 Coat all joints with oxide inhibitor.

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list:

- .1 Frames of motors.
- .2 Motor control centres.
- .3 Starters.
- .4 Control panels.
- .5 Cable trays.

END OF SECTION

Part 1 General

Part 2 Products

2.1 STAINLESS STEEL SUPPORT CHANNELS

.1 U-shape, size 21 × 41 mm, 2.5 mm thick, surface mounted, suspended, or set in poured concrete walls and ceilings.

.2 U-shape, size 41 × 41 mm, 2.5 mm thick, surface mounted suspended set in poured concrete walls and ceilings.

.3 H shape, size 82 × 41 mm, 2.5 mm thick, surface mounted suspended set in poured concrete walls and ceilings.

2.2 FIBREGLASS SUPPORT CHANNELS

.1 Fiberglass support channels to be used in Category 2 locations.

2.3 ANCHORS

.1 Approved for use in the project's seismic zone by manufacturer.

2.4 FASTENINGS

.1 One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for 2 or more cables at 3 mm centers.

.3 Threaded rods: 6 mm diameter to support suspended channels.

.4 To be: 316 SS or electrogalvanized steel Cobra P-style clamps for unistrut.

2.5 BEAM CLAMPS

.1 Approved for use in the project's seismic zone by manufacturer.

.2 Complete with seismic restraints.

.3 Unistrut P series Universal Beam Clamp or equivalent.

.4 Beam clamps shall be mounted so ensure they are plumb to minimize bends of the ready rod.

Part 3 Execution

3.1 INSTALLATION

.1 Contractor to de-burr all cut edges and apply de-oxidizing compound or paint to the cut edge of steel support channels.

.2 Contractor to apply de-oxidizing compound to all ground lug terminations.

.3 Secure equipment to hollow and solid masonry, tile, and plaster surfaces with steel anchors or nylon shields.

.4 Follow anchor manufacturer's instructions and comply with weight tolerances.

.5 Secure equipment to poured concrete with expandable inserts.

.6 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.7 Secure surface mounted equipment with twist clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.

.8 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.9 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole aluminium straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel Work.

.10 Suspended support systems:

- .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
- .2 Support two or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.11 For surface mounting of 2 or more conduits, use channels at 3 m on centre spacing.

.12 Provide metal brackets, frames, hangers, clamps and related types of support structures, where indicated, or as required to support conduit and cable runs.

.13 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.14 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.15 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant,.

.16 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA) C22.1, Canadian Electrical Code Part 1.

.2 Canadian Standards Association (CSA International):

.1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.

.2 CSA C22.2 No. 45, Rigid Metal Conduit.

.3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.4 CSA C22.2 No. 83, Electrical Metallic Tubing.

.5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

.6 CAN/CSA C22.2 No. 227.3, Non-metallic Mechanical Protection Tubing (NMPT), A National Standard of Canada.

1.3 CONDUITS

.1 Rigid metal conduit to CSA C22.2 No. 45, aluminum threaded.

.2 Epoxy coated conduit to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT) to CSA C22.2 No. 83, with weather proof couplings that allow for ground continuity.

.4 Rigid PVC conduit to CSA C22.2 No. 211.2.

.5 Flexible metal conduit to CSA C22.2 No. 56, liquid-tight flexible metal.

.6 Flexible PVC conduit to CAN/CSA-C22.2 No. 227.3.

.7 Conduit type as indicated in Drawings.

.8 For hazardous location use, unless specified otherwise rigid metal conduit will be used. galvanized rigid steel threaded conduit or threaded aluminum conduit for Category 1 or 2.

.9 For corrosive areas, unless specified otherwise use:

.1 Rigid PVC conduit.

.10 Use electrical metallic tubing (EMT) above 2.4 m or where not subject to mechanical damage. Aluminum above grade in non-corrosive environments and steel above or below grade with protective coating for corrosion.

.11 Motor/vibrating equipment connections:

.1 Use flexible metal conduit for connection in dry areas.

.2 Use liquid tight flexible metal conduit for connection in damp, wet or corrosive locations.

.3 Use explosion proof flexible connection for connections in zone classified areas.

.4 Flexible runs shall not exceed the maximum distance allowed by CEC Part 1.

1.4 CONDUIT FASTENINGS

.1 One-hole steel straps to secure surface conduits 50 mm and smaller.

.2 Two-hole steel straps for conduits larger than 50 mm.

.3 Beam clamps to secure conduits to exposed steel work.

.4 Channel type supports for two or more conduits at 1.5 m on centre.

.5 Threaded rods, 6 mm diameter, to support suspended channels.

1.5 CONDUIT FITTINGS

.1 Fittings: Manufactured for use with conduit specified. Coating: Same as conduit.

.2 Ensure factory "ells" where 90° bends for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.

.4 Set-screws are not acceptable.

.5 Grounding must be maintained throughout the raceway.

1.6 FISH CORD

.1 Polypropylene fit for intended purpose.

.2 For spare conduit, prior to closing conduit with end cap, fish cord:

.1 To be taped to inside of end cap.

.2 Or, taped near end of conduit such that it is accessible in the future.

1.7 MANUFACTURERS

.1 Schedule 40 PVC type:

.1 IPEX, Scepter Series.

.2 Allied Tube and Conduit, Schedule 40 PVC.

.3 Carlon Plus 40® Series.

.4 Cantex, Forte-Duct® Conduit - UL Schedule 40.

.2 Galvanized rigid metal conduit:

.1 Allied Electrical Group.

.2 Or approved equivalent.

.3 Schedule 80 PVC type:

.1 IPEX, Super Duct Series.

.2 Carlon Plus 80® Series.

.3 Allied Tube and Conduit, Schedule 80 PVC.

.4 Cantex, Schedule 80.

.4 EMT:

.1 Allied Electrical Group.

.2 Republic Conduit.

.3 Tomas & Betts.

.4 Or approved equivalent.

Part 2 Execution

2.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

2.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.1 Contractor to make every effort to conceal conduits in public areas from easy view. Exception for mechanical and electrical service rooms and in unfinished areas.

.2 Conceal conduits except in unfinished areas and in mechanical and electrical service rooms.

.3 Use EMT above 2.4 m not subject to mechanical injury.

.4 Use rigid PVC conduit underground and in corrosive areas.

.5 Use flexible metal conduit for connection to motors in dry areas work in movable metal partitions and connection to fixtures.

.6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.7 Use explosion proof flexible connection for connection to explosion proof motors.

.8 Install conduit sealing fittings in hazardous areas. Fill with compound.

.9 Minimum conduit size for lighting and power circuits: 19 mm.

.10 Bend conduit cold. Replace conduit if kinked or flattened more than $^{1}/_{10}^{th}$ of its original diameter.

.11 Mechanically bend steel conduit over 19 mm diameter.

.12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.13 Provide grounding clamps on the unions where the length of non-threaded conduit exceeds the allowed distance in the CEC Part 1.

.14 Install fish cord in empty conduits.

.15 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.16 Dry conduits out before installing wire.

2.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CAN/CSA C22.1 No.126.1, Metal Cable Tray Systems.

.2 CAN/CSA C22.1 No.126.2, Non Metallic Cable Tray Systems.

.2 National Electrical Manufacturers Association (NEMA):

.1 NEMA FG 1, Fibreglass and Cable Tray Systems.

.2 NEMA VE 1, Metal Cable Tray Systems.

.3 NEMA VE 2, Cable Tray Installation Guidelines.

.3 Section References:

.1 Section 26 05 00 - Common Work Results for Electrical.

.2 Section 26 05 28 - Grounding Secondary.

Part 2 Products

2.1 CABLE TROUGH

.1 To be provided for below grade or under road installations.

.2 Solid covers for complete cable trough system including fittings.

.3 Barriers where different voltage systems are in same cable trough.

2.2 CABLE TRAY

.1 Cable tray fittings: To CAN/CSA C22.1 No. 126.1 (metallic) and No. 126.2 (non-metallic).

.2 Unless indicated otherwise in drawings, cable tray to be Class C, ladder type, with supports every 3 m maximum:

.1 Tray material to be aluminum, stainless steel, or fibreglass.

.2 Size to be as indicated on drawings where shown with a depth of 150 mm, and rungs spaced 300 mm, unless noted otherwise on the drawings.

.3 Fittings: Horizontal elbows, end plates, dropouts, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cable tray supplied.

.4 Radii on fittings: 600 mm minimum for all other trays, unless noted otherwise on the Drawings.

.5 Barriers where different voltage systems are in same cable tray.

.6 Ground cable trays within 1 m of MCC and every 15 m afterward with a minimum #2 AWG Green TWU copper conductor attached to each tray section in accordance with CEC requirements, 12-2208 and 10-616 for larger than 500 A cables.

.7 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Cooper B-Line.

.2 Superior Tray.

.3 Thomas and Betts.

.4 Unitray.

.5 Or approved equivalent.

2.3 FIRE PROOFING/BARRIERS

.1 Roxtec fire proofing shall be used for weatherproof fire penetrations.

.2 Hilti Brick shall be used for non-weatherproof penetrations.

.3 Provide fire proofing for all fire rated openings and walls.

2.4 SUPPORTS

.1 Provide splices, supports as required.

.2 Supports shall be non-combustible, 304L stainless steel for hardware, rods, and clamps; and steel for channels.

Part 3 Execution

3.1 INSTALLATION

.1 Install complete system: To CSA 22.1.

.2 The Drawings show main runs only. Additional cable tray branch runs and drops to equipment shall be supplied and installed by the Contractor.

.3 Support cable trough, tray, and mesh on both sides.

.4 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

.5 Coat cut edges of steel tray with anti-corrosion coating or paint.

.6 Cable trays shall be grounded in accordance with the CEC and Section 26 05 28 – Grounding - Secondary.

.7 Contractor shall provide adequate supports under cable tray fittings to prevent sagging of tray rungs under weight of cables.

.8 Cable trays are only to support cables. Contractor shall not attach pipes, fixtures, and the like to cable tray or cable tray supports.

.9 Contractor shall provide additional branch cable trays or channels where more than 2 cables run in the same direction from the main cable tray runs.

.10 X-ray floors before cutting concrete and mark the location of rebar do not cut rebar.

.11 Cables in cable trough:

.1 Install cables individually.

.2 Lay cables into cable trough. Use rollers when necessary to pull cables.

.3 Secure cables at 6 m centres minimum with nylon ties.

.4 Use 304L stainless steel straps to secure 5 kV Teck cables in both vertical and horizontal cable tray runs.

.5 Identify cables at the ends and every 30 m with Size 2 nameplates, in accordance with Section 26 05 00 – Common Work Results for Electrical.

.12 Fire barriers:

.1 Provide fire barriers for all fire rated walls and openings.

.2 Arrange for opening in fire rated walls and floors for width and depth of cable tray to run tray through.

.3 Block out openings before concrete is poured and notify Structural Engineer and Consultant how many rebar will be affected.

.4 Arrange and make good fire rating of floors or walls after cables have been installed.

.5 For above grade areas, Hilti brick, Roxtec or equivalent shall be used.

.6 For below grade areas or areas under pressure, seals shall be capable of holding hydrostatic water pressure on one side of the seal, whilst the other side is dry:

.1 Roxtec seals or equivalent shall be used.

.2 All seals shall be complete with packing wedges, stay plates, and sealing blocks as required by the cables to be installed.

.3 Seal modules bonded as required.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems.

.2 IEEE 519 - Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

.3 IEEE Std. 1566 - Standard for Performance of Adjustable Speed AC Drives Rated 375kW and Larger.

.4 IEEE Std. C57.18.10, Practices and Requirements for Semiconductor Power Rectifier Transformers.

.5 NEMA Standards Publication No. MG1, Motors and Generators.

.6 Occupational Safety and Health Administration (OSHA) Standard 3074 - Hearing Conservation.

1.2 DESCRIPTION

.1 The following Specification describes the minimum requirements for the design, fabrication, test, installation, and documentation of the variable frequency drive (VFD) controller.

.2 The functional characteristics of the VFD shall configured to match the performance characteristics of the pumps they are driving.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for VFDs and include product characteristics, performance criteria, physical size, finish, and limitations.

.2 Include final approved Drawings in the operation and maintenance (O&M) manual.

.3 Include thermal operating characteristics.

.4 Shop drawings and the O&M manual shall include filter information. Filters shall be standard and readily stocked type and size, or to be custom size cut from a readily stocked filter media available in rolls.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Specifications.

.2 O&M data: Submit O&M data for VFDs for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions and with Section 01 61 00 - Common Product Requirements.

.2 Delivery and acceptance requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and handling requirements:

.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect VFDs from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable manufacturers:

.1 ABB ACQ580 drive in NEMA 4 enclosure. (DC swing choke can eliminate need for line reactor in this application to be confirmed by Supplier).

.2 Alternatives to be declared in Section 01.

2.2 EQUIPMENT REQUIREMENTS

.1 The VFD shall be rated for variable torque or horsepower to match application. Contractor to verify and match to application:

.1 Constant torque for eccentric screw pumps or VFD shall have quadratic/dynamic torque control.

.2 Variable voltage or current source VFDs shall not be provided.

.3 Motor cables to be 1 voltage category higher than the motor voltage.

.4 The individual drives will be capable of being controlled from the facility’s programmable logic controller (PLC) control system or site supervisory control and data acquisition (SCADA) system.

.5 The individual drives will be capable of being controlled from the facility’s PLC connected from the HLP RIO-601 to the Low Lift PLC switch back to the operator control room PLC.

.6 Unless indicated otherwise on the Drawings:

.1 The VFDs shall have a 1 min overload current rating of 150% and a 2 second overload current rating of 250% for constant torque drives. The VFDs shall have a 1 min overload current rating of 110% for variable torque drives.

.7 Any harmonic calculations shall be done based on the kVA capacity, X/R ratio and the impedance of the utility transformer feeding the installation, as noted on the Drawings,

and the total system load. The calculations shall be made with the point of common coupling being the point where the utility feeds multiple customers.

.8 Total harmonic distortion shall be calculated under worst-case conditions in accordance with the procedure outlined in IEEE Standard 519. Copies of these calculations are to be made available upon request. Contractor shall provide any needed information to the VFD supplier 3 weeks prior to requiring harmonic calculations.

.9 The VFDs shall be able to start into a spinning motor. The VFDs shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the pre-set speed.

.10 Power factor:

.1 The VFD shall be capable of maintaining a minimum power factor (Displacement P.F. X Distortion P.F.) of .95 from 60-100% load.

.2 If the VFD vendor cannot meet the power factor requirement, then a power factor correction unit shall be quoted as an option.

.11 Efficiency:

.1 VFD efficiency shall be a minimum of 95% efficient at 100% speed and 100% load.

.2 Control power supplies, control circuits, cooling fans or pumps, shall be included in all loss calculations.

.12 Environmental ratings:

.1 Contractor to ensure the storage ambient temperature range as per manufacturer recommendations.

.2 Operating minimum ambient temperature range: 0°C to 40°C without derating.

.3 The relative humidity range is 0% to 95% non-condensing.

.13 Audible noise level:

.1 The maximum audible noise from the variable frequency drive shall comply with OSHA Standard 3074, Hearing Conservation.

.2 Variable frequency drives with audible noise in excess of this limit must be provided with sufficient noise abatement treatment to reduce the sound pressure level below 85 dB(A).

.14 Input reactor:

.1 Line filter shall be integral to the VFD. May be eliminated based on drive selection with DC choke.

.15 Output filter:

.1 The drive shall have an output load reactor as a filter. The filter shall be used to attenuate voltage spikes at motor terminals (output of VFD). The filter shall be with the following:

.1 Rated 5% of the load.

.2 Rated 600V, sized for motors full load current.

.3 One year warranty.

.4 Where runs are greater than 100 m, the dV/dT shall be replaced with a sine wave filter located at the motor. If not practicable, the dV/dT will remain.

.16 The system containing the VFDs shall comply with the 5% level of total harmonic distortion of line voltage and the line current limits, as defined in IEEE 519-1992. If the system cannot meet the harmonic levels with the VFDs provided with the standard input line reactor or optional input isolation transformer, the VFD manufacturer shall supply an engineered harmonic mitigation solution. The solution shall be shown to meet the requirements of IEEE519 (through calculation or software simulation), based on the power system data supplied to the manufacturer.

.17 VFD inverter section:

.1 In the output inverter, the order of preference for the type of power switching device will be Insulated Gate Bipolar Transistors (IGBT) transistors and then Darlington transistors. Gate Turn-Off Thyrister (GTO) and Silicon Controlled Rectifier (SCR) are not acceptable.

.2 The variable frequency drive shall provide stable operation of the motor without compromising the motor insulation system, regardless of motor cable distance. The vendor shall clearly state the limitations in motor cable distance with the proposal. If an output filter is required to mitigate reflected waves, or to meet any special requirements of the application, it must be integral to the VFD controller.

.3 Frequency stability of ±0.05% for 24 hrs with voltage regulation of ±1% of maximum rated output voltage.

.4 Speed regulation of ±0.5% of base speed.

.5 Load inertia dependant carry over (ride through) during utility loss.

.6 Insensitive to input line rotation.

.18 Load side harmonics:

.1 The VFD vendor must provide load side harmonic mitigation to protect the load.

.2 Harmonic mitigation shall be in accordance with the manufacturer's design.

2.3 CONTROLS

.1 Provide remote station for HMI to be located on the wall away from the VFD enclosure.

.2 All control wiring to be Ethernet TCP/IP, discrete wiring will not be used.

.3 Unless indicated otherwise in the Drawings, at a minimum, the VFD shall provide the following control system interface signals to the facility control system:

Description	Convention	Remarks
Speed control	Minimum speed (0%) as determined by pump requirements to max speed (100%=60Hz).	Reference speed from external control system.

Description	Convention	Remarks
Motor feedback parameter frequency	0 to max speed (100%).	Signal to external control system representing actual motor rotating frequency.
Motor feedback parameter current (optional)	0 to max current (100%).	Signal to external control system representing actual drive output motor current.
Ready to Start	Signal when VFD is in positioned to accept and act upon "motor run" signal from external control system.	Signal to external control system; Not ready if VFD in "off" or "hand/manual" position.
Start / Stop	Hold to Run and Release to Stop.	Signal from external control system to run VFD if "ready to run"; VFD shall stop if signal not present and run.
Trip	Open when VFD in alarm condition.	Signal to external control system.
Emergency Stop	Disconnects power to control logic on VFD.	Fail safe signal to terminate VFD operation.

.4 The VFDs shall have the following common system interface input requirements:

.1 Inputs: A minimum of 6 programmable digital inputs, 2 analogue inputs shall be provided with the following available as a minimum:

.1 Remote manual/auto.

.2 Remote start/stop.

.3 Remote forward/reverse.

.4 Remote pre-set speeds.

.5 Remote external trip.

.6 Remote fault reset.

.7 Process control speed reference interface, 4-20m ADC.

.8 Potentiometer and 0-10 VDC speed reference interface.

.9 RS-232 programming and operation interface port.

.2 Outputs: A minimum of 2 discrete programmable digital outputs, 1 programmable open collector output, and 1 programmable analogue output shall be provided, with the following available at minimum.

.1 Programmable relay outputs with 1 set of form C contacts for each, selectable with the following available at minimum:

.1 Fault.

.2 Run.

.3 Ready.

.4 Reversing.

.5 Jogging.

.6 At speed.

.7 In torque limit.

.8 Motor rotation direction opposite of commanded.

.9 Over-temperature.

.2 Programmable open collector output with available 24 VDC power supply and selectable with the following available at minimum:

.1 Fault.

.2 Run.

.3 Ready.

.4 Reversing.

.5 Jogging.

.6 At speed.

.7 In torque limit.

.8 Motor rotation direction opposite of commanded.

.9 Over-temperature.

.3 Programmable analogue output signal, selectable with the following available at minimum:

.1 Output current.

.2 Output frequency.

.3 Motor speed.

.4 Motor torque.

.5 Motor power.

.6 Motor voltage.

.7 DC link voltage.

.3 Provide digital communication protocol:

.1 Modbus TCP/IP.

.5 Protective functions:

.1 The VFD shall include the following protective features at minimum:

.1 Over-current.

.2 Over-voltage.

.3 Inverter fault.

.4 Under-voltage.

.5 Phase loss.

.6 Output phase loss.

.7 Under-temperature.

.8 Over-temperature.

.9 Motor stalled.

.10 Motor over-temperature.

.11 Motor under-load.

.12 Logic voltage failure.

.13 Microprocessor failure.

.14 DC injection braking.

.2 The VFD shall provide ground fault protection during power-up, starting, and running. VFD with no ground fault protection during running is not acceptable.

.6 Diagnostic features:

.1 Fault history:

.1 Record and log faults.

.2 Indicate the most recent first and store up to 9 faults.

.7 Control wires:

.1 All wire to be tagged, labelled from factory.

.2 Control wiring shall be kept separate from power wiring. Cut-outs and gasketed removable cover plates shall be provided by the manufacturer to facilitate routing of cables installed in the field.

2.4 ENCLOSURE

.1 The arrangement of equipment inside the cabinet shall be such that rear access is not required. Preference will be given to modular design (i.e., rack-out sections or modules), for efficient repair and troubleshooting.

.2 All indicators and control devices shall be accessible with the front door(s) closed.

.3 At minimum VFDs mounted:

.1 Process areas shall be NEMA 4 – or drives can be mounted in rated enclosure.

.2 Or as specified in Drawings.

.4 The VFD shall and be complete with the following components:

.1 All materials and equipment shall be new.

.2 Standard catalogue items and NEMA/CSA Type sizes, rating capacities and voltages shall be given preference.

.3 Furnish equipment to include all the necessary features, components, accessories, and apparatus to make a fully functional system.

.4 VFD Grounding shall be as VFD manufacturer’s installation requirements

.5 VFD enclosures or MCC sections shall be complete with air filters on intake fan vents. Dust-tight IP or NEMA rating is not required:

.1 Filters shall be externally mounted and accessible for replacement without opening the MCC or enclosure.

2.5 COMPONENTS – BUSSING

.1 All bus work shall be constructed of tin plated copper. Aluminum bus bars are not acceptable.

2.6 SOURCE QUALITY CONTROL

.1 Permit the conduction of equipment inspection at manufacturer’s plant.

.2 Provide manufacturer’s type test certificates.

.3 Submit written test results to the Consultant.

.4 Include written test results in the VFD section of the maintenance manual.

Part 3 Execution

3.1 UNLOADING AND STORAGE

.1 The Contractor shall be responsible for delivery and unloading of the equipment to the Project Site. The Contractor shall be responsible for proper storage, including any pre-installation preparation and care per instructions from the manufacturer.

.2 Protect against dust, damage, temperature, and weather during entire construction period.

3.2 INSTALLATION

.1 Install variable speed drives, as shown on the Drawings, and in accordance with manufacturer’s specifications and recommendations.

.2 The Contractor shall supply, install, and terminate all power, control, and ground cables in accordance with the Drawings.

.3 Grounding:

.1 Motor return ground wire should be terminated at the VFD chassis ground prior to the system (VFD equipment) ground.

3.3 FIELD QUALITY CONTROL

.1 Provide the services of a qualified manufacturer's employed Field Service Engineer to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of VFD on the job site. Sales representatives will not be acceptable to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, installation as specified in manufacturer’s installation instructions, wiring, application dependant adjustments, and verification of proper VFD operation.

.2 The Contractor under the technical direction of the manufacturer’s service representative shall perform the following minimum work:

.1 Inspection and final adjustments.

.2 Operational and functional checks of VFD and spare parts.

.3 The contractor shall certify that they have read the drive manufacturer’s installation instructions and has installed the VFD in accordance with those instructions.

.3 The Contractor shall provide 3 copies of the manufacturer's field start-up report before final payment is made.

3.4 START-UP TESTING AND COMMISSIONING

.1 Retain the service of the manufacturer’s representative for commissioning of the equipment after installation. Testing to be in accordance with Section 26 05 01 –

Electrical Field Inspection, Testing and Commissioning and shall include but not be necessarily limited to:

.1 All equipment will be function tested, calibrated and load tested.

.2 Prior to performing any tests or applying power to the drives, it is the Contractor's responsibility to verify all cable and wiring connections as well as equipment setup and mounting arrangement (i.e., foundation, cable entry, etc.).

.3 The manufacturer's representative shall fully configure the VFD controls for the operational requirements of the pumping system.

.4 Configuration documentation shall be signed and dated by the manufacturer's representative and included in the F.

.5 Settings (unless indicated otherwise):

.1 The VFD shall be configured to not restart the motor upon restoration of power.

.2 The VFD minimum speed shall be set to 40% speed.

.3 The VFD carrier frequency shall be configured to work with the output filter as per manufacturer recommendations.

.6 Provide Owner with electronic copy of all VFD setting and configuration file as part of the O&M manual.

.7 Contractor to inspect the bearing grease at the end of the commissioning period. If there is any degradation, the Contractor shall install common mode filters.

3.5 CLEANING

.1 Contractor shall install filters with the enclosure and replace filters throughout construction as they become dirty.

.2 Upon completion of all dust generating work and final cleaning, fresh filters shall be installed and 2 spares for each filter shall be provided.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

1.2 Conform to the following reference standards as specified in Division 01.

1.3 OPERATING AND MAINTENANCE DATA

.1 Provide as specified in Division 01.

1.4 SUBMITTALS FOR REVIEW

.1 Provide as specified in Division 01.

.2 Submit document listing pipe, fittings, flexible connectors, linings, coatings, and valving to be used for each pipe system.

.3 Radiographic Weld Testing: Submit the name and qualifications of at least two independent firms for the radiographic weld testing to be undertaken by the Contractor. The selected firm will be subject to the review and acceptance of the Engineer.

.4 Manufacturer's affidavit of compliance with specified AWWA standards for valves, pipe, fittings, linings, and coatings.

.5 Design, select, locate and provide piping supports, pipe guides, seismic bracing, expansion joints and anchors required for final piping layout. Typical details and acceptable attachments shown on the drawings are provided only for general guidance.

.6 Provide the necessary submittals and ensure the proper registration of piping systems and system components as required by the regulatory authorities having jurisdiction.

1.5 SUBMITTALS FOR INFORMATION ONLY

.1 For all pipe greater than or equal to 50 mm diameter, submit isometric drawings, to indicate the assembly details, the welds, flanges, valve placement, cathodic protection, seismic restraint system, expansion joints, guides, anchors, hangers, supports, and the provisions for thrust restraint, as well as any other pertinent details.

.2 Submit piping layout drawings by plant area which indicate location and placement of valves, fittings and other appurtenances for all piping, greater or equal to 150 mm diameter, in that area. Indicate location and clearances from structures and other utilities (ductwork, conduit, electrical tray, etc.).

.3 Submit copies of all original submittals and all related correspondence made as part of the regulatory submissions required by regulatory authorities.

.4 Product Samples: Where specified or when directed by the Engineer, provide mill test results or product samples.

.5 Provide hanger, expansion joint, guide, anchor, support and seismic restraint system design details including locations, load information, design calculations and illustrative

drawings, stamped and signed by a Professional Engineer registered in the Province of Ontario.

.6 For expansion joints submit manufacturer's catalogue data, shop drawings and assembly drawings confirming general arrangement, dimensions, and tolerances, materials of construction, weights and installation details. Submit calculations to substantiate expansion joint selection and amount of precompression, stamped and signed by a professional Engineer registered in the Province of Ontario.

.7 Welding: Prior to commencing any welding of stainless steel pipe, prepare and submit to the Engineer a written description of welding techniques including but not limited to materials, methods, and quality control. Identify differences in shop and field techniques. Indicate in the submission that the welding technique has been reviewed for each commodity and certify that the technique is acceptable for the intended service condition. Written procedures to be stamped and sealed by a Professional Engineer registered in the Province of Ontario and qualified for welding design.

.8 Radiographic weld test results.

.9 Submit current and complete documentation of the welder's qualifications prior to the commencement of welding.

1.6 PIPE MATERIALS - GENERAL

.1 All pipe materials to be new, free from defects and conforming to applicable reference standards.

.2 All materials, linings and coatings in contact with water to be NSF approved for potable water.

.3 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the current standard.

1.7 PIPE SIZES

.1 Where the pipe size is not specified, provide pipe with the sizes required by the Plumbing Code. Small piping not described by the Plumbing Code or otherwise specified herein shall be 12 mm nominal diameter.

1.8 JOINTS - GENERAL

.1 Connect piping using joints not readily disassembled only where shown and where not otherwise specified. Provide joints which may be disassembled at the minimum, within 1.0 m of any connection to equipment, on both sides of structural penetrations, within 0.6 m of all threaded end valves, and at the spacing specified in the detailed piping specification sheets.

.2 For carbon steel piping less than 75 mm in diameter, butt-weld or use threaded couplings. Use unions where disassembly is required.

.3 For steel piping equal to or greater than 75 mm in diameter, where not specified or shown otherwise, butt-weld according to ASME Boiler and Pressure Vessel Code or furnish

slip-on flanges, conforming to ANSI B16.5, Class 150. Unless indicated otherwise on the drawings or detail specifications, where disassembly is required, use flanges.

.4 For stainless steel tubing use stainless steel compression fittings.

.5 For schedule rated stainless steel pipe smaller than 75 mm in diameter, socket-weld pipe. Where disassembly is required, use threaded unions.

.6 For thin wall or schedule rated stainless steel pipe equal to or greater than 75 mm in diameter, butt-weld pipe unless otherwise shown or specified.

.7 For copper or brass piping, use soldered couplings. Where disassembly is required, use compression unions.

.8 For ductile iron piping, where not shown or otherwise specified, and for other piping where specified or shown, use grooved joints in accordance with AWWA C606.

.9 Where not shown or otherwise specified, use solvent weld joints for PVC and FRP piping. Provide flanges or unions where disassembly is required.

Part 2 Products

2.1 PROCESS PIPE

.1 Refer to drawing for pipe materials details.

.2 Piping through slabs and walls to be Schedule 40 stainless steel.

.3 Stainless Steel Process Piping shall be Schedule 10S 316 stainless steel or as noted otherwise on plans and specifications and excluding slab and wall penetrations.

2.2 FLANGES

.1 Make flanges on stainless steel piping stainless steel slip-on, or weld neck type, or with a galvanized steel back-up ring drilled to ANSI B16.1, Class 125. Make the angle ring thickness equal or greater than the pipe or fitting to which it is welded.

.2 General requirements for flanges are as follows:

.1 Compatible flanges for mating to equipment or valves.

.2 Provide flat-faced flanges on each side of butterfly valves.

.3 Do not use slip-on flanges that are attached to a pipe by means of set screws and gaskets.

2.3 SOLDERED COUPLINGS

.1 Soldered couplings for copper pipe conform to ANSI B16.26. Solder to be lead free conforming to ASTM B32 and the Plumbing Code.

2.4 THREADED COUPLINGS

.1 Make screwed joints using American Standard threads to ANSI B1.20.1.

.2 Use Teflon tape as thread lubricant for threaded joints.

.3 Conform to ASTM A182 or ASTM A276, Class 150, for threaded connections to stainless steel pipe, threadolets to be shop welded to the pipe at the locations specified.

.4 Provide threaded-end to flanged-end adaptors where required to connect to flanges.

2.5 EQUIPMENT CONNECTIONS

.1 Unless specified otherwise provide the following pipe end for equipment connections. See below for Dissimilar Metal Connections.

	Equipment End: Tubing/Various	Equipment End: Brass or Bronze Female Thread	Equipment End: Cast Iron or Steel Female Thread
Piping Material	**Pipe End (Diameter Range)**		
a) Stainless Steel: Tubing	(6 - 25 mm) Nut and Double Ferrule Type Connectors or Adaptors as Required Rating: Class 1000	(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250	(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250
b) Stainless Steel: Gauge & Schedule 10S		(10 - 65 mm) Socket Weld Nipple and Union Rating: Class 3000	(10 - 65 mm) Socket Weld Nipple and Union Rating: Class 3000
c) Stainless Steel: Schedule 40S		(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250	(10 - 65 mm) 150 mm SS Threaded Nipple and Union Rating: Class 250
j) PVC: Schedule 80		(10 - 65 mm) 150 mm PVC Nipple and Union Rating: Schedule 80	(10 - 65 mm) 150 mm PVC Nipple and Union Rating: Schedule 80

2.6 FITTINGS

.1 For steel pipelines 75 mm in diameter or greater, fittings to conform to ANSI B16.9, ANSI B16.11 or ANSI B16.5. Provide fittings with a wall thickness equal to or greater than the pipe. In steel pipelines less than 75 mm in diameter provide threaded malleable iron fittings, conforming to ANSI B16.3.

.2 Provide butt welding fittings in stainless steel pipelines less than 75 mm of the same class as the pipe, conforming to ASTM A403 and ANSI B16.11. Provide socket welding fittings in stainless steel pipelines less than 75 mm to Cl. 3000, same material as the pipe, and ANSI B16.11. Fabricate fittings in stainless steel pipelines equal to or greater than 75 mm in diameter using similar materials and classes as the pipe and conform to ASTM A774.

.3 Provide concentric reducers in vertical lines unless indicated otherwise.

.4 Provide long radius elbows unless otherwise shown. Provide smooth flow carbon or stainless steel elbows 350 mm and less, to ANSI B16.9. Provide mitred elbows greater than 350 mm, to AWWA C208 unless otherwise shown or specified. Use 3-piece construction unless otherwise shown or specified.

2.7 GASKETS

.1 For flat faced flanges, use full-face gaskets. For raised-face flanges, use ring type gaskets. Conform to ASTM B16.21.

.2 Use gasket materials for flanged connections suitable for the temperature, pressure, and corrosivity of the fluid conveyed in the pipeline. Refer to detailed pipe specifications for recommended gasket material. Material designations used in the detailed pipe specification sheets are as follows:

.1 EPDM: ethylene-propylene-diene-terpolymer 70 durometer.

.2 Bl. Neoprene: neoprene (black) 70 durometer.

.3 Nitrile: nitrile (Buna N).

.4 SBR: Styrene-butadiene (red).

.5 Natural rubber: natural rubber.

.6 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400), and neoprene binder: 1.7 MPa (ASTM F152), 0.2 mL/h Leakage Fuel A (ASTM F37).

.7 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400) and SBR binder: 1.7 MPa (ASTM F152), 0.1 mL/h Leakage Fuel A (ASTM F37).

.8 Gylon - Type 1: Garlock Style 3500, 1.35 MPa (ASTM F152), 0.22 mL/h Leakage Fuel A (ASTM F37).

.9 Gylon - Type 2: Garlock Style 3510, 1.35 MPa (ASTM F152), 0.04 mL/h Leakage Fuel A (ASTM F37).

.10 CPE - Chlorinated Polyethylene.

.3 Unless otherwise specified, minimum Gasket Material Thickness for full face gaskets:

.1 75 to 250 mm pipe diameter; 1.6 mm thick.

.2 Greater than 250 mm pipe diameter; 3.2 mm thick.

.4 Unless otherwise specified, minimum gasket material thickness for raised face ring gaskets:

.1 75 to 100 mm pipe diameter; 1.6 mm thick.

.2 Greater than 100 mm pipe diameter; 3.2 mm thick.

2.8 BOLTS AND NUTS

.1 Provide hex head bolts and nuts. Threads to be ANSI B1.1, standard coarse thread series.

.2 For general service, use bolts and nuts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A. For general interior service, use bolts and nuts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A.

.3 For general interior service stainless steel, use bolts and nuts conforming to ASTM B193/A320 Grade B8 Class 2; nuts conforming to ASTM F594, GRADE 2 CW2.

.4 Provide stainless steel bolts, nuts and washers for submerged, buried and concrete encased service; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr.8. For exposed (exterior), submerged, buried and concrete encased service, provide stainless steel bolts, nuts and washers; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr.8.

.5 Provide hot dip galvanized bolts, nuts and washers for use with hot dip galvanized Van Stone flange back-up rings and Lap-joint flange back-up rings.

.6 Provide hex nuts equal to or less than 25 mm. Greater than 25 mm, provide heavy hex.

2.9 DISSIMILAR METAL CONNECTIONS

.1 Where dissimilar metals are to be connected, furnish dielectric fittings and/or isolating flanges.

2.10 DRAIN VALVES

.1 Locate at all low points and section isolating valves unless otherwise specified.

.2 Minimum 20 mm size unless otherwise specified: straight pattern bronze with hose end male thread and complete with cap and chain.

Part 3 Execution

3.1 VALVES AND EQUIPMENT IDENTIFICATION

.1 Valves and equipment are identified in the following manner:

.1 Valve Identification:

.1 Valve Designation Example:

100 - GAV - A1

Where:

100	Size
GAV	Identity Symbol
A1	Line Code

.2 Valve Identity Symbols

SYMBOL	**VALVE TYPE**
AVV	Air Vacuum Valve
BAV	Ball Valve
BUV	Butterfly Valve
BV	Block Valve
CHV	Check Valve
()CV	Control Valve () - Primary Controlled Variable Valve May Have Several Functions F - Flow rate P - Pressure L - Level S - Surge T - Temperature
NEV	Needle Valve

.3 Valve Marking: Each valve to bear the manufacturers name or trademark and reference symbol to indicate the service conditions for which the manufacturer guarantees the valve. The marking to be in accordance with MSS-SP-25.

.4 Valve Tagging: Valves to be tagged as follows:

GAV - 105 - 30
Component
Sequence Number
Valve Symbol

.2 Equipment Identification

SYMBOL	EQUIPMENT
()P	Pump
	() - Primary May Have Several Functions
	LL – Low Lift
	HL – High Lift

3.2 PIPING INSTALLATION

.1 General:

.1 Conform to requirements of ANSI B31 code for pressure piping.

.2 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.

.3 Install groups of piping parallel to each other, spaced to permit application of insulation, identification, and service access, on trapeze hangers.

.4 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

.5 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

.6 Install flanged or welded nozzles, branch connections, welding outlets, adapters and taps, true and faced at right angles to the axis of the pipe. Do not extend connection inside of pipe.

.7 Make pipe ends round and true, suitable for weld connection.

.8 Prepare pipe ends in accordance with ANSI B16.25 for butt welding.

.9 Copper pipe and tubing to be free from surface damage. Replace damaged pipe or tubing.

.10 Ream ends of pipe and tubes before being made up.

.11 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.

.12 Use non-corrosive lubricant or teflon tape applied to male thread only.

.13 Groove pipe ends, cut square, seating surface clean and free from indent and score marks.

.14 Install dielectric fittings wherever piping of dissimilar metals are joined.

.15 Install flanges or unions to permit removal of equipment without disturbing piping systems, as required by piping standard.

.16 Clean ends of pipes or tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.

.17 Support piping during construction to prevent abnormal stresses on the pipe works.

.18 Install pipe supports where indicated on the drawings or as required.

.19 Install pipe hangers as required.

.2 Flanges Bolting to Valves:

.1 Do not weld adjacent flanges on butterfly valves when the valve is in place.

.2 Remove valve prior to welding.

.3 Clean gasket surfaces, flange faces and butt welding connections.

.4 Protect connecting surfaces.

.3 Bolted Connections:

.1 Clean pipe ends and gaskets.

.2 Lubricate gaskets with soapy water and bolts with thread lubricant.

.3 Tighten bolts progressively by crossover method and not in rotation around the joint.

.4 Tighten bolts to the torque recommended by the manufacturer.

.5 Use properly sized wrenches for bolt tightening to prevent rounding of nut and bolt heads.

.4 Branch Connections: branch connections to be in accordance with the following for ANSI 150, 300, 600, 900 and 1500 ratings:

BRANCH

MAIN	20	25	40	50	65	75	100	150	200	250
20	T									
25	RT	T								
40	RT	RT	T							
50	C	TH	RT	T						
65	C	RT	RT	RT	T					
75	C	C	C	RT	*RT	T				
100	C	C	C	*W	*RT	RT	T			
150	C	C	C	*W	*RT	W	RT	T		
200	C	C	C	*W	*W	W	W	RT	T	
250	C	C	C	*W	*W	W	W	RT	RT	T
300	C	C	C	*W	*W	W	W	RT	RT	RT
350	C	C	C	*W	*W	W	W	RT	RT	RT
400	C	C	C	*W	*W	W	W	RT	RT	RT
450	C	C	C	*W	*W	W	W	W	RT	RT
500	C	C	C	*W	*W	W	W	W	RT	RT
600	C	C	C	*W	*W	W	W	W	W	W

BRANCH

MAIN	300	350	400	450	500	600
300	T					
350	RT	T				
400	RT	RT	T			
450	RT	RT	RT	T		

500	RT	RT	RT	RT	T	
600	RT	RT	RT	RT	RT	T

Legend: T - Straight Tee RT - Reducing Tee
TH - Thredolet C - Coupling
W - Weldolet

*For Class 150 - A1 line class, including A1A and A1B, but not A1C, piping 65 mm size and under to be screwed connections. The branch connections will, therefore, be TH (thredolet).

3.3 VALVES INSTALLATION

.1 Storage of Valves:

.1 Store valves in cool and clean location, away from moving vehicles or other objects.

.2 Prevent dirt and debris entering the valve internals.

.3 Protect the valve seats against painting.

.4 Store valves with their handwheels, operator shafts and operators in an upright position.

.2 Handling Valves:

.1 Do not place chains, cables and ropes through valve ports or attached to operators or handwheels.

.2 Use sling either around valve body or with bolts or rods through the flange holes.

.3 Installation of Valves:

.1 Installation of valves to be by competent personnel and in strict accordance with manufacturer's instructions.

.2 Inspect pipe and remove all foreign debris or objects that may prevent closing of valves prior to the installation of any valves.

.3 Install butterfly valves with their operating shafts in the vertical position unless otherwise directed by the Engineer.

3.4 PROTECTION OF OPENINGS

.1 Protect equipment and system openings from dirt, dust and other foreign materials.

.2 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign substances prior to being put into operation.

3.5 EQUIPMENT PIPING CONNECTIONS

.1 Where equipment connections are a different size from the piping serving it all associated isolating valves and fittings to be the larger pipe size unless specifically indicated otherwise on the drawings. This rule to also apply in the case of control valves.

3.6 SLEEVES

.1 Provide individual metal sleeves for all pipes, tubes or ducts penetrating all walls and floor slabs. Grout tightly in place for full depth of wall or slab.

.2 Standard sleeves to be 22 Ga. galvanized sheet steel with lock seam joints.

.3 Use cast iron or steel pipe sleeve with annular fin continuously welded at midpoint:

.1 Through foundation walls.

.2 Where sleeve extends above finished floor.

.4 Sizes:

.1 Refer to mechanical drawings for details.

.2 Provide 6 mm clearance all around, between sleeves and pipe or between sleeve and insulation.

.5 Terminate sleeves flush with surface of concrete and masonry and above floors.

.6 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water-tight, durable joint.

.7 Voids Around Pipes:

.1 Caulk between sleeve and pipe in foundation walls and below grade floors with oakum and PC-4 caulking compound between sleeve and pipe.

.2 Where sleeves pass through walls or floors, caulk space between sleeve and insulation or between sleeve and pipe with dry oakum. Seal space at each end of sleeve with waterproof, fire retardant, non-hardening mastic.

.3 Ensure no contact between copper tube or pipe and ferrous sleeve.

.4 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.

.8 Where pipes and ducts pass through walls and floors having a fire separation rating, pack the space with approved caulking material and seal in accordance with CGSB 19-GP-9.

3.7 CUTTING AND PATCHING

.1 Minimize cutting and patching required. Set sleeves and mark openings in concrete forms and masonry structure prior to the placement of concrete or masonry.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This section refers to the disinfection, hydrostatic and pressure testing of all water retaining structures and piping (new and existing).

.2 All new water retaining or carrying pipes and surge tanks shall be tested for leakage.

.3 All new water retaining or carrying pipes and structures shall be disinfected including but not necessarily limited to the following:

.1 Pump body and pump suction and discharge piping.

.4 Disinfect any equipment in contact with potable water.

.5 The Contractor shall furnish the disinfecting chemicals, suitable temporary service connections, testing plugs or caps, pressure pumps, pipe connections, gauges, thrust supports, and all other required equipment and labour necessary for filling the structure, expelling air, and dewatering the structure without additional compensation.

.6 Coordinate with local utility personnel during testing and disinfection.

Part 2 Products

2.1 WATER

.1 All water used for the initial disinfection, hydrostatic and pressure testing shall be supplied by the Owner at no cost to the Contractor. However, all water required for retesting, following failure of their initial test, will be supplied by the Owner at the Contractor's expense (rate will be based on current residential rates).

.2 The Contractor shall be responsible for the supply and installation of all temporary pipework, pumps and other equipment required to transport the water from the Owner's point of supply.

.3 The Contractor shall provide the Owner and with at least seventy-two (72) hours of notice of his requirement for water for testing.

.4 All water used for disinfection and pressure testing to be of potable quality as defined by the latest edition of the Guidelines for Canadian Drinking Water Quality.

2.2 CHLORINE

.1 Chlorine used in disinfection shall be either hypochlorite solution or liquid chlorine conforming to the AWWA B300 and B301 Standards, latest editions, respectively.

Part 3 Execution

3.1 CLEANING

.1 Prior to disinfection and/or hydrostatic or pressure testing, all water retaining structures, pipework and conduits shall be thoroughly cleaned. All dirt and loose material shall be removed.

.2 Cleaning shall include all necessary provisions to thoroughly wash down interior surfaces, and to remove all wash down water and solids from the pipe or structure.

.3 Leave all systems operating with work areas clean to the satisfaction of the

3.2 DISINFECTION

.1 Combine hydrostatic testing with disinfection procedure and submit details of proposed method to the

.2 Disinfection of water mains shall be in accordance with the latest edition of ANSI/AWWA C651, Disinfecting Water Mains.

.3 Disinfection of potable water storage reservoirs and/or pump wells shall be in accordance with the latest edition of ANSI/AWWA C652, Disinfection of Water Storage Facilities. Disinfection of the remaining non-potable tankage shall consist of flushing and hydrostatic testing using clean potable water.

.4 Disinfection of the pump station components shall be in accordance with the latest edition of ANSI/AWWA C653, Disinfection of Water Treatment Facilities. Disinfection of the remaining non-potable tankage shall consist of flushing and hydrostatic testing using clean potable water.

.5 The Contractor shall provide a means of testing the concentration of the chlorine disinfection solution.

3.3 DISINFECTION OF STRUCTURES AND PIPING

.1 The structures or pipework shall be disinfected during the hydrostatic or pressure testing by adding chlorine or a chlorine compound to the water to produce an initial concentration of at least 25 mg/L. After a twenty-four (24) hour period, there shall be a residual of chlorine of at least 10 mg/L. Following this contact period, all valves on the piping system shall be operated to ensure that all parts have been in contact with the chlorine solution. This water shall be retained in the structure/pipeline for a minimum period of seventy-two (72) hours. If repair work is required following the hydrostatic or pressure testing, the Contractor shall disinfect the repaired areas to the Engineers satisfaction.

.2 At the completion of the leakage and disinfection test, further flushing and filling with potable water shall be undertaken by the Contractor before bacteriological tests are carried out by the Contractor under the supervision of Engineer. The Contractor shall not put the piping system into service without the approval of Engineer following receipt of a negative bacteriological test.

.3 If there is any indication of contamination, the Contractor shall be required to repeat disinfection. This shall be done by the Contractor at his expense, under the supervision of Engineer.

3.4 MIXING OF CHLORINE SOLUTION

.1 Mixing of chlorine solutions shall conform to the manufacturer's instructions. Methods and procedures shall be subject to the approval of Engineer.

3.5 DISPOSAL OF DISINFECTING AND TESTING WATER

.1 Dispose of water used for spray disinfection and the initial testing of the reservoir into the surface drainage system at a rate, which will not cause hydraulic overloading. The Contractor is responsible for the necessary chemical to de-chlorinate and equipment

required to pump the test water to the drain or into existing sewage collection system. Disposal of disinfection waters to comply with Saskatchewan's regulations.

3.6 INSTRUMENTATION PROTECTION

.1 All instruments that have a maximum range of less than the hydrostatic or pneumatic test pressure shall be removed or isolated during the pressure test. On successful completion of the system test, the pressure shall be lowered and re-pressured if required to a pressure within the range of the instruments, and the isolated or removed instruments shall then be tested in accordance with other sections of these specifications.

3.7 PRESSURE TESTING OF PIPING

.1 Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least five (5) days after placing concrete or two (2) days if high early strength concrete is used.

.2 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.

.3 Pipeline should be left at low pressure for a period of forty-eight (48) hours prior to testing to saturate concrete lining where applicable.

.4 Thoroughly examine exposed parts while under pressure and correct for leakage as necessary. Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.

.5 The amount of leakage during the test period shall be zero. Repeat pressure test until all defects have been corrected and no loss of water is observed.

.6 Pressure testing shall be conducted on the pipelines to the pressures and durations as follows, (or the maximum rated pressure of the pipeline whichever is less):

Pipe Description	**Test Pressure (kPa)**	**Duration (hours)**
Steel Piping, Class 150	1030	4
Steel Piping, Class 300	2060	4
Stainless Steel Piping, Sch. 10 and higher	1030	4
PVC Process Piping, Sch. 40 and higher	690	4
Chemical System Piping, Sch. 40 and higher	690	4
Pressure Drains	*as per pipe type	4
Gravity Drains (floor, roof, etc.)	Leak test only by plugging and filling lines	4

3.8 DEFECTS AND REPAIRS

.1 Defects disclosed in the work shall be made good and retested or the work replaced without additional cost to the Owner.

.2 Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Where it becomes necessary to replace pieces or pipe, such replacements shall be the same lengths as the defective pieces. Where repairs are required to PVC pipe, the pipe shall be replaced as far as the first detachable fitting in each direction from the defect. Under no circumstances shall a new section of pipe be installed with solvent welded couplings.

.3 Tests shall be repeated after any work has been replaced if, in the judgement of the Engineer, it is necessary.

.4 All pressure testing shall be done in the presence of the

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Submit product data in accordance with Division 01.

1.2 REFERENCE STANDARDS

.1 The Manufacturer shall ensure product meets standards in accordance with Division 01.

1.3 OPERATION AND MAINTENANCE MANUAL

.1 Provide operation and maintenance data for incorporation into manual specified in Division 01.

1.4 QUALITY ASSURANCE

.1 Valves are to be marked in accordance with MSS SP-25.

.2 Valves to comply with latest AWWA standards.

1.5 SHIPMENT, PROTECTION AND STORAGE

.1 Deliver valves to site using loading methods which do not damage casings or coatings.

.2 Clearly tag valves, stating size, type, coatings and mating parts.

.3 Store on site until ready for incorporation in the work using methods recommended by manufacturer to prevent damage, undue stresses, or weathering.

1.6 IDENTIFICATION

.1 Provide nameplates on all valves. Nameplate is to identify valve tag number.

.2 Nameplates:

.1 Lamicoid 3 mm thick plastic engraving sheet, black face, white core.

Nameplate Sizes

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.3 Identify valves with Size 6 nameplates or as directed by Engineer.

.4 Wording on nameplates to be approved by Engineer prior to manufacture.

.5 Allow for average of ten letters per nameplate.

.6 Identification to be English.

.7 Mechanically fasten nameplates to valve with 304 stainless steel wire rope 3 mm diameter with aluminum swage sleeve permanently crimped.

Part 2 Products

2.1 GENERAL

.1 Provide valves of the same type, size range and service from a single manufacturer.

.2 Provide new, unused valves for the work.

.3 Valve materials to be free from defects or flaws, with true alignment and bores.

.4 Unless otherwise indicated, valves shall be the same size as the pipe run in which they are to be installed.

.5 Clearly mark valve bodies in raised lettering to indicate the valve type, rating, and where applicable, the direction of flow. Conform to MSS SP-25.

.6 Valves to open counter-clockwise.

2.2 DRAWINGS

.1 Process schematics indicate major process valves required for the process to operate as intended.

.2 Detailed process drawings, process standard drawings, yard piping drawings and service piping schematics indicate the valves on the process schematics plus other valves required for isolation.

2.3 VALVE ENDS

.1 In pipe runs less than 75 mm diameter, provide valves with female threaded ends, unless indicated otherwise. Threads to conform to ANSI B1.20.1.

.2 Valves, in pipe runs equal to or greater than 75 mm diameter, to be flanged unless indicated otherwise.

.3 For cast iron body valves, drill flanges to Class 125 pattern conforming to ANSI B16.1. For steel body valves, flanges to be Class 150 pattern conforming to ANSI B16.5 or as noted.

.4 Lug style wafer body valves shall have tapped holes, suitable for the bolt spacing of the pipe flanges placed on either side.

.5 Wafer body valves shall have positioning holes, suitable for the bolt spacing of the pipe flanges placed on either side.

.6 End flanges for gate valves to be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1, Class 125 flanges.

2.4 MANUAL OPERATORS

.1 Provide valves with manual operators unless specifically indicated otherwise.

.2 For hand wheels, clearly show direction of opening in raised lettering and symbols.

.3 Hand wheel diameter to conform to the following:

Nominal Valve Size (mm)	Minimum Hand Wheel Diameter (mm)
12	50
20	50
25	60
38	75
50	85
65	105
75	200
100	250
150	300
200	350
250	400
300	450
350	450
400	550
450	600
500	600

.4 Maximum rim pull on a hand wheel not to exceed 300 N when one side of the valve is at test pressure and the other side is at atmospheric pressure. Provide gear operator where a shaft mounted hand wheel would require greater than this force to operate. Unless different operators are scheduled or shown in the drawings, conform to the following minimum requirements:

.1 Gate Valves: less than 300 mm, hand wheel; equal to or greater than 300 mm, gear operator.

.2 Globe and Needle Valves: less than 200 mm, hand wheel; equal to or greater than 200 mm, gear operator.

.5 Match existing operating nuts. Provide two eight-point operating wrenches.

.6 Supply stem extensions and valve boxes for buried valves. Provide two operating tees.

.7 Lever operators to conform to the following dimensions:

Nominal Valve Size (mm)	Minimum Length of Lever (mm)
6	80
12	80
20	100
38	150
50	150
65	150
75	175
100	225
150	250

.8 Quarter turn lever operators to be perpendicular to the pipe run when the valve is closed.

.9 Lever operators on ball valves to be two position. Provide butterfly valves with 10 position latching levers except where used to balance air flows. Where used to balance air flows provide infinite position, screw down levers.

.10 Maximum pull at the end of the lever arm not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. Provide a gear operator where greater than this force would be required to operate the valve with a lever. Conform to the following minimum requirements unless different operators are scheduled or shown in the drawings:

.1 Ball Valves: less than 150 mm, lever operator; greater than or equal to 150 mm, gear operator.

.2 Butterfly Valves: less than 150 mm, lever operator; greater than or equal to 200 mm, gear operator.

.11 Gear operator to be worm gear type, equipped with a hand wheel and a visual indicator of the valve position. Equip operators with adjustable, self-locking mechanical stop-limiting devices designed to hold the valve in any intermediate position between full open and full closed to prevent overtravel of the disc/ball in the open and closed positions. Gear operators to be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant.

.12 Provide chain wheel gear operators for manual valves on lines 75 mm and greater, mounted over 2.0 metres above the operating floor. Design the operator so that a force of 150N is sufficient to open the valve when one side of the valve is at test pressure and the other side is at atmospheric pressure. The chain pulley to mesh positively with the chain. Chain to extend from valve operator to operating height 1.2 metres above the floor or as directed by the Engineer. Exact dimensions to be field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.

2.5 VALVE STEM EXTENSIONS

.1 Provide valve stem extensions where additional clearance is required for pipe insulation or where valve operation without the extension is difficult and in manholes.

.2 Where angle valve stem extensions are employed, they shall be angle geared. Universal joint types are not permitted.

2.6 VALVE SCHEDULE

.1 Valve schedule is provided for all major process valves.

.2 All valves which specify limit switches shall have both open and closed limit switches, factory mounted.

.3 Valve Schedule:

2.7 VALVES

.1 Stainless Steel Ball Valves - 100 mm and smaller

.1 Location: P1R, P2R, and P3R

.2 Size: 15 mm (1/2”)

.3 Rating: 2000 psi WOG

.4 Body: stainless steel

.5 Ball: stainless steel
.6 Stem: brass, stainless steel
.7 Packing: PTFE
.8 Seat: PTFE
.9 Operator: stainless steel lever
.10 End connections: FNPT
.11 Approved Manufacturers:
.1 Crane
.2 Watts
.3 Nibco

.2 Needle Valve

.1 Location: HLP1R, HLP2R, and HLP3R
.2 Size: 15 mm (1/2”)
.3 Body: 316 SS
.4 Bonnet: 316 SS
.5 Adapter Locknut: 316 SS
.6 Adapter: 316 SS
.7 Dustcap: Nylon
.8 Handle: 304 SS
.9 Screw: 304 SS
.10 Fastening Screw: 304 SS
.11 Needle / Needle Tip: 316 SS
.12 Gland Washer: 304 SS
.13 Gland Packing: PTFE/Graphite
.14 Dwell Pin: 304 SS
.15 Gland Packing: PTFE/Graphite
.16 Approved Manufacture:
.1 Wkia
.2 Winters

.3 Butterfly Valve - sizes 100 mm and larger (BUV)

.1 Location: P1R, P2R, and P3R
.2 Size: 100 mm (4”)
.3 Rating: 1050 kPa (150 psi) working pressure
.4 Body: ductile iron, lug style
.5 Coating: NSF-61epoxy coating inside/outside
.6 Disc: 316 stainless steel
.7 Shaft: 416 stainless steel
.8 Seat: EPDM
.9 Packing: Buna-N
.10 Approved Manufacturers:
.1 Bray
.2 Keystone

.4 Ball Check Valve - 150 mm and larger (CHV)

.1 Type: Sinking Ball Check Valve.
.2 Location: P1R, P2R, and P3R
.3 Size: 250 mm (10”)
.4 Pressure Rating (Seating): 1035 kPa.
.5 Materials:
.1 Ball: Aluminum encapsulated with NBR rubber.
.2 Body/Bonnet: Ductile iron ASTM A536.
.6 Coating: NSF-61epoxy coating inside/outside.
.7 Connection: Flange ANSI B16.1 Class 125 RF flange.
.8 Approved Manufacturer:
.1 Flygt (HDL).
.2 Golden Anderson/VAG
.3 Valmatic.

.5 Air Release Valves (ARV)

.1 Location: P1R, P2R, and P3R
.2 Size: 100 mm (4”)
.3 Body: Cast Iron ASTM A126, CLASS B
.4 Cover: Cast Iron ASTM A126, CLASS B
.5 Baffle: Ductile Iron ASTM A536, GRADE 65-45-12
.6 Seat: Buna-N
.7 Float: Stainless Steel T316, ASTM A240
.8 Gasket: Compressed Non-Asbestos Fiber
.9 Cover Bolt: Alloy Steel SAE, GRADE 5
.10 Retaining Screw: Stainless Steel T316, ASTM F593
.11 Guide Bushing: Stainless Steel T316, ASTM A240
.12 Pipe Plug: Steel
.13 Guide Shaft: Stainless Steel T316, ASTM A240
.14 Connections:
.1 Outlet: ANSI B16.1 Class 125 RF flange
.2 Inlet: FNPT
.15 Rating: 1035 kPa (150 psi)
.16 Chcck valve:
.1 Type: center guided silent check
.2 Body: ductile iron, globe style
.3 End conns: 150# ANSI flange
.4 Trim: bronze/stainless steel
.5 Stainless steel spring
.17 Seat: resilient (Buna-N or EPDM)
.18 Approved Manufacturers:
.1 APCO
.2 Golden Anderson/VAG

.3 Val-Matic

.6 Gate Valve Outside Screw & Yoke – 100 mm to 300 mm

.1 Size: 250 mm
.2 Cap Nut:Bronze
.3 Hand Wheel: Ductile Iron
.4 Washer: Bronze
.5 Bush Nut: Bronze
.6 Yoke: Ductile Iron
.7 Stem: Bronze
.8 Gland Flange: Ductile Iron
.9 Stem Packing: Lub. Flax
.10 Bonnet: Ductile Iron
.11 Bonnet O-ring: Nitrile Rubber
.12 Body: FL Ends Ductile Iron
.13 Stem Nut: Bronze
.14 Encapsulated Disc: EPDM
.15 Disc Casting: Ductile Iron
.16 Guide Cap: Acetal
.17 Gland Bolt: 316 Stainless Steel
.18 Gland Nut: Bronze
.19 Cap Screw: 316 Stainless Steel
.20 Bonnet bolts: 316 Stainless Steel
.21 Bonnet nuts: 316 Stainless Steel
.22 Pin: 304 Stainless Steel
.23 O-ring: Nitrile Rubber
.24 Approved Manufacture:
.1 Clow/Kennedy
.2 Mueller
.3 Watts

.7 Electric Check Pump Control Valve

.1 Location: HLP1R
.2 Style: Globe Style solenoid pilot with manual operator
.3 Type: Eletrco-hydraulic controller, V-ported differential piston design, and full ported.
.4 Body type: Globe Style with integral flanges
.5 Size: 300 mm (12”)
.6 End Conn: ANSI B16.1 Class 125 FF flange
.7 Body: Cast iron c/w 2-part NSF-61epoxy coating inside/outside
.8 Cover: ASTM A36 Steel
.9 Internal Trim: Lead-free bronze
.10 Seat & Seal: Buna-N
.11 Pilot System: Lead-free brass

.12 Indication: Visual position indicator to be provided

.13 Fasteners: Stainless Steel

.1 Stainless Steel 316 for internal and external

.14 Approved Manufactures:

.1 Golden Anderson/VAG (Model: 1730D

.2 Cla-Val

.3 Singer

Part 3 Execution

3.1 PREPARATION

.1 Valve and piping arrangement indicated in the drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in piping to allow for discrepancies between valve dimensions shown and those supplied for the work.

.2 Field measure and check all equipment locations, pipe alignments, and structural installation prior to installation of valves. Ensure that valve locations and orientations provide suitable access to manual operators and that sufficient space and accessibility is available for pneumatic and electric actuators.

.3 Where conflicts are identified, inform the Engineer and initiate the necessary piping modifications at no cost to the Owner.

3.2 VALVE INSTALLATION

.1 In horizontal pipe runs, other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.

.2 Mount butterfly valves and trunnion ball valves with shaft in a horizontal orientation.

.3 Do not over-torque bolts to correct for misalignment when joining valves to pipe or fittings,

.4 Support valves in position using temporary supports until valves are fixed in place.

.5 Permanently support valves to prevent transmission of loads to adjacent pipework and/or equipment.

.6 Where valves are installed in PVC pipework greater than 100 mm diameter, support valves independently and brace against operating loads and torque to prevent transmission of stresses to adjacent pipework.

.7 Install gate valves in the closed position.

.8 Install valves which are bubble tight in one direction to seal in a direction opposite to normal flow unless otherwise noted or directed by the Engineer.

.9 Unless otherwise specified, install single seated ball valves and knife gate valves with the seat downstream. Install at tank connections with seat away from tank. Install on pump discharge and suction lines with seat adjacent to the pump.

.10 Install all valves in accordance with manufacturer's recommendations.

3.3 VALVE TESTING

.1 Operate valves under simulated and/or real process conditions to ensure operation as intended.

.2 Valves to be pressure tested in conjunction with the pipes in which the valves are installed.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This section contains detailed piping specifications.

Part 2 Products

2.1 PIPING IDENTIFICATION

.1 The drawings designate the size and line service specification of pipe to be supplied by the Contractor in the following manner:

.1 Line Identification: Line identification is placed on each line in the following manner:

150 - PW - A1 - A - D - 105

Where:

150	Line Size
PW	Commodity
A1	Piping Line Code
A	Internal Lining
D	External Pipe Coating
1	Plant Component (if required)
05	Line Number (if required)

e.g. 150 mm line size, potable water, steel -1900 kPa rating, cement mortar lined, yellow jacket coated, component 1, line No. 05.

.2 Commodity Symbols for Line Identification

SYMBOL	COMMODITY
PW	Potable Water
VE	Vent

.2 Line Code E1 as follows:

SERVICE: VE,DR	LINE CODE: E1
PRIMARY FLANGE RATING: CLASS 150	DESIGN PRESSURE: 1900 kPa
TEMPERATURE (MAX): 40°C	CORROSION ALLOWANCE:

ITEM	SIZES	GENERAL DESCRIPTION
Pipe	150 mm & smaller	PVC, rigid, to CSA B137.3, Sch. 80.
Fittings	150 mm & smaller	PVC, socket weld, Sch. 80.

.3 Line Code H1 as follows:

SERVICE: PW	LINE CODE: H1
PRIMARY FLANGE RATING: Class 150	DESIGN PRESSURE: 1000 kPa
TEMPERATURE (MAX): 40°C	CORROSION ALLOWANCE: N/A

ITEM	SIZES	GENERAL DESCRIPTION
Pipe	65 mm & up	Austenitic stainless steel, to ASTM A312 Grade TP316L, Sch. 10S seamless or electric- fusion welded (no filler), cold worked annealed, pickled and passivated as per ASTM A380 and ASTM A967, hydrostatically tested, mill certified.
	50 mm & less	Austenitic Stainless steel tubing to ASTM A213 / A269, annealed, Grade TP316L., Sch. 10S.
Fittings	50 mm & less	Austenitic stainless steel, forged, to ASME B16.11 ASTM A182, Grade 316L Class 2000/3000 socket-welded fittings or NPT threaded fittings to ASME B16.11 and B1.20.1.
	65 mm and up	Austenitic stainless steel, factory-made wrought fittings to ASME B16.9 and ASTM A774, rated for design pressure of pipe , ASTM A403 Grade WP316L, MSS-SP-43, Sch. 10S, butt weld ends
Flanges	65 mm and up	Forged stainless steel to ASTM A182 F316L, ANSI B16.5, weld neck or slip-on, Class 150, Raise face or flat face to match the flange to be mated to.
Bolts	All sizes	To ASTM A193 Grade B8.
Bolts for Lug Style Iron Body Valves	All sizes	ASTM A193 Grade B7 hex head; Nickel-Cadmium plated.
Nuts	All sizes	Stainless steel, hex head to ASTM A194. Grade 8
Gaskets	All sizes	EPDM, ring type for RF flanges, full face for FF flanges, 3 mm thick.

SERVICE: PW	LINE CODE: H1
PRIMARY FLANGE RATING: Class 150	DESIGN PRESSURE: 1000 kPa
TEMPERATURE (MAX): 40°C	CORROSION ALLOWANCE: N/A

ITEM	SIZES	GENERAL DESCRIPTION
Flexible coupling	Less than DN600	Victaulic Style 77, ductile iron body, "E" EPDM, SS Bolts and nuts, galvanized coating
Rigid coupling	80-300/300-600	Victaulic Style 89/W89, ductile iron body, "E" EPDM, SS Bolts and nuts, galvanized coating
Flange Insulating Gasket Kits	All sizes	Flange insulating gasket kit – Type E (for flat face) or Type F (for raised face) double insulating gasket including bolt insulating sockets and washers. Product: Advance Product & Systems Inc., or approved alternate.
Dismantling Joint	100 mm to 400 mm	Steel flange adapter with Class 150, AWWA C207 Flat face flange or raised face where required. Product: Robar 7506DJ.

.4 Line Code H3 as follows:

SERVICE: PW	LINE CODE: H3
PRIMARY FLANGE RATING: N/A	DESIGN PRESSURE: 20000 kPa
TEMPERATURE (MAX): 40°C	CORROSION ALLOWANCE: N/A

ITEM	SIZES	GENERAL DESCRIPTION
Tubing	6mm to 12 mm 16 mm to 20 mm	Austenitic stainless steel to ASTM A213/ A269 Grade TP316/316L. Wall Austenitic stainless steel to ASTM A213/ A269 Grade TP316/316L. Wall thickness: 2.0 mm.
Fittings	All sizes	Stainless steel 316 compression fittings, Double Ferrule Type Connectors or Adaptors as Required Rating: Class 1000. Acceptable Manufacturers: Swagelok and Parker.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Supply, install and commission complete Programmable Logical Controller (PLC) System.

.1 System to be complete with all hardware and cables required for a fully functional system.

1.2 SUBMITTALS

.1 Submit programmer qualifications as part of bid package.

.2 Submit Shop Drawings for the following:

.1 PLC Hardware BOM and data sheets, including but not limited to each module, backplane, and CPU.

.2 Remote I/O, including but not limited to I/O radio equipment and remote terminal units.

.3 Shop Drawings for hardware shall identify at minimum:

.1 Model number.

.2 Number of I/O points.

.3 Communications protocols supported.

.4 Memory capacity for CPUs and other modules with memory.

.4 Logical-programming software, identifying:

.1 Exact software license.

.2 Tag count.

.3 Ownership details.

.3 Closeout submittals:

.1 Provide all Shop Drawings, including reviewed sheets, identified for inclusion in Operations and Maintenance (O&M) manual.

.2 Provide a copy of all license documentation, including but not limited to forms, stickers, serial numbers, registration numbers, and email addresses for inclusion in O&M manual.

.3 Where customized communication cables are used, provide pin-out diagrams for all cables used.

Part 2 Products

2.1 CONTROLLER

.1 Provide PLC Hardware in accordance with Drawings.

.2 Provide all communication cables, terminations, and connectors to complete the PLC as shown on the Drawings.

.3 All software and software licenses purchased as part of the project or on BOM to be turned over to Owner at completion of contract. Software and residual support to be registered in Owner's name.

.4 Provide all network interfaces, control system accessory equipment and software that is not designated but is required for an integrated and working control system platform.

Part 3 Execution

3.1 INSTALLATION

.1 Reference Drawings and install the PLC equipment as shown.

.2 Connect PLC cards, as shown on the PLC Wiring Drawings.

3.2 PROGRAMMING

.1 All software and software licenses to be turned over to Owner at completion of contract. Software and residual support contracts (if any) to be registered in Owner's name.

.2 All programming code shall be fully commented in English. Logical code sections must include a general description of the intended operation of the code section:

.3 The use of PLC code generation software is not allowed. Code may use pre-programmed blocks or Defined Functions Blocks (DFB) but bulk of coding is to be custom generated by the integrator.

.4 Contractor to provide qualified Personnel for PLC and HMI programming:

.1 Programming Personnel must have a minimum of 5 yrs' documented experience programming similar equipment controlling similar-scale systems within the water and wastewater industry.

.2 Consultant retains the right to demand proof of the programmer's qualifications and to reject unqualified integrators.

.5 PLC program to conform to Control Philosophy and HMI/PLC design guidelines.

.6 All design and programming clarifications to be submitted to Consultant.

3.3 INTEGRATION

.1 Contractor shall provide complete integration of new system to existing SCADA. Providing required signals and PLC/HMI modifications to existing systems to facilitate the completion and integration of this Project are the Contractor's responsibility.

3.4 FACTORY ACCEPTANCE TESTING

.1 Provide a factory acceptance test plan, according to Division 01, for review by Consultant prior to scheduled FAT. The test plan should include a procedure for testing all aspects of the logic of the controller programs, including communication to all devices, alarms, shutdown, failure modes, and any other features of the logic.

.2 Provide a 100% completion factory acceptance test at 50% overall Project completion, witnessed by the Consultant and designated representatives of the Owner, at the Contractor's programming facility. If FAT test is not conducted, payment will be withheld. Execute all tests as described in the test plan and correct any Deficiencies to the satisfaction of the Consultant The test may be conducted in multiple sessions that correspond to major components of the process (no more than 5 different sessions). Sessions may require multiple days of witnessed testing. Tests are to be performed using actual controllers and I/O cards being provided for the Work. FAT test will not be conducted on client's premises. Programming cannot be done on a "live" system. Programming and testing on a "live" working system is unacceptable.

.3 Provide written documentation of all tests successfully completed with Deficiencies corrected to Consultant.

.4 Test to include:

- .1 Description of test: Identify the testing procedure and expected outcome, including method of simulation and/or use of HMI controls.
- .2 Tag: Identify the PLC tag(s) associated with the testing procedure.
- .3 PLC logic: Check box indicating the expected PLC logic was verified.
- .4 HMI Animation: Check box indicating the expected HMI animations where verified.
- .5 Alarm level: Check box indicating confirmation of the expected alarm level.
- .6 Contractor sign-off.
- .7 Consultant sign-off.

3.5 SITE ACCEPTANCE TESTING (SAT)

.1 Provide a site acceptance test plan, according to Division 01, for review by Consultant prior to the scheduled SAT. The test plan should be substantially like the FAT test plan with changes applicable to site testing.

.2 Provide a site acceptance test for each unit process, prior to commissioning, witnessed by the Consultant and designated representative(s) of the Owner, at the Owner's facility. Execute all tests as described in the test plan and correct any Deficiencies to the satisfaction of the Consultant.

.3 Provide written documentation of all tests successfully completed, with Deficiencies corrected, to Consultant.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This section covers the components required for logical interconnection of the PLC components. Work includes installation and testing of Ethernet cabling, jacks, termination panels, hubs, switches, and routers.

1.2 STANDARDS

.1 All equipment and assemblies of equipment shall be approved by a testing laboratory accredited by the Standards Council of Canada. An official mark or label of the agency indicating that the product has been independently assessed for safety must be included on each assembly and all equipment supplied.

.2 All copper Ethernet cabling, end connectors, jacks, termination panels, hubs, switches, and routers shall comply with the latest revision of EIA/TIA 568.1, Commercial Building Telecommunications Cabling Standard.

.3 All fibre Ethernet cabling, jacks, termination panels, hubs, switches, and routers shall comply with the latest revision of EIA/TIA 568B.3, Optical Fibre Cabling Components Standard.

.4 All copper Ethernet hardware, including but not limited to cables, switches, and routers shall comply with IEEE 802.3 100BASE-TX or better.

.5 All single mode fibre Ethernet hardware, including but not limited to cables, switches, SFP modules, and routers shall comply with IEEE 802.3 100BASE-LX10 or better.

.6 All multi-mode fibre Ethernet hardware, including but not limited to cables, switches, SFP modules, and routers shall comply with IEEE 802.3 100BASE-FX or better.

1.3 SHOP DRAWINGS

.1 Provide Shop Drawings which shall include but not be limited to:

- .1 Product data sheets for Ethernet equipment, including:
  - .1 Copper/Fibre Ethernet cables.
  - .2 Ethernet switches.
  - .3 Routers.
  - .4 Patch panels (copper and fibre).
- .2 Fibre optic installation procedure.

1.4 QUALITY CONTROL SUBMISSIONS

.1 Submit, as a Shop Drawing, all Ethernet test results prior to site acceptance test described in Section 40 – Programmable Logic Controllers.

.2 IP address schedule for all network equipment, including subnet mask and default gateway for managed network equipment, including managed switches and routers.

1.5 REFERENCE SPECIFICATIONS

.1 Division 26.

.2 Division 40.

1.6 OPERATIONAL AND MAINTENANCE INFORMATION

.1 Provide final IP address schedule for IP-enabled equipment, including, but not limited to managed switches, routers, Ethernet-enabled PLCs, HMIs, power meters, drives, etc.:

.1 IP schedule shall identify at minimum:

.1 Equipment tag/identification.

.2 MAC address.

.3 Port Number(s)/Interface Number(s) to which MAC address applies.

.4 IP Address assigned to MAC address.

.5 Subnet mask assigned to IP address.

.6 Default gateway, if assigned to IP address.

.2 Provide patch panel schedules for all copper and fibre patch panels with more than one port. Schedule shall identify at minimum:

.1 Patch panel tag/identification.

.2 Terminated cable tag(s).

.3 Terminated cable destinations.

.4 Port Numbers to which cables are terminated.

.3 Provide software configuration exports in both paper copy and electronic usable form for:

.1 Managed Ethernet switches.

.2 Routers.

Part 2 Products

2.1 General

.1 Network connections and devices shall operate using Fast Ethernet or better. All components will be capable of auto-negotiating or 100 Mbps.

.2 Copper cabling shall be used within a common power supply area, and optical fibre shall be used between power supply areas.

.3 Notwithstanding design Drawings, all runs of Ethernet greater than 90 m shall use multi-mode optical fibre not copper.

.4 Ethernet cable shall be routed to minimize run length to the extent possible within the standards for bending radius, necessary support, proximity to EMF interference sources and other physical constraints.

2.2 COPPER ETHERNET CABLES

.1 Indoor copper Ethernet cables shall be:

.1 Unshielded.
.2 Category 5e.
.3 Unarmored.

.2 Copper Ethernet cables shall follow the following colour code:

.1 Black: OT/SCADA networks.
.2 White: IT/internet connected networks.
.3 Blue: Security network – not PoE.
.4 Pink: Security network – PoE.
.5 Yellow: Camera network – Not PoE.
.6 Red: Camera network – PoE.

.3 Copper Ethernet cables shall be labelled in accordance with Division 26.

.4 Unless shown otherwise, copper Ethernet cables shall be tagged as “CETH-XXX” where XXX is a unique index.

2.3 DIN-RAIL-MOUNT COPPER PATCH PANEL

.1 Where shown, and where shielded copper Ethernet runs between enclosures including DIN, terminate copper Ethernet cables to DIN-Rail-Mount Copper Patch Panels.

.2 Panels shall be unshielded.

.3 Panels shall use keystones.

.4 Acceptable manufacturers:

.1 Belden.
.2 Phoenix Contact.
.3 Or Engineer approved equivalent.

2.4 RACK-MOUNT ETHERNET SWITCHES

.1 Where shown on Drawings, rack-mount Ethernet switches shall be complete with minimum 24-port copper 8P8C ("RJ45") connections and shall be capable of being expanded/stacked to add additional switch ports managed from a single interface. Switches to be provided complete with mounting hardware for standard 19″ rack.

.1 Uplink ports:

.1 2 SFP sockets fitted with SFP modules providing single-mode gigabit fibre ports..

.2 Switches shall be capable of:

.1 Secure Shell (SSH) command line interface or have a web page:

.1 Internet Group Management Protocol (IGMP) Packet snooper/querier, configured to drop needless traffic.

.2 IEEE 802.1q VLAN tagging.

.3 Rapid-Spanning Tree Protocol (RSTP).

.4 Device-Level Ring (DLR).

.5 Power over Ethernet (PoE).

.6 Power over Ethernet Plus (PoE+).

.7 Integral Modbus TCP server for monitoring switch status.

.8 Integral EtherNet/IP server for monitoring switch status.

.9 SNMP v 2.0 for monitoring switch status.

.3 Power supply:

.1 120 VAC; fed from PDU.

.4 Approved manufacturers:

.1 Cisco.

.2 HP.

.3 Juniper.

2.5 DIN-RAIL MOUNTED ETHERNET SWITCHES

.1 Where shown on Drawings, DIN-rail mounted Ethernet switches shall be installed in field cabinets/enclosures per Drawings. Unless indicated otherwise in Drawings, switches to have a minimum of four 8P8C (“RJ-45”) copper ports.

.2 Switches shall be capable of:

.1 Secure Shell (SSH) command line interface or have a web page.

.2 Internet Group Management Protocol (IGMP) packet snooper/querier:

.1 Internet Group Management Protocol (IGMP) Packet snooper/querier, configured to drop needless traffic.

.2 IEEE 802.1q VLAN tagging.

.3 Rapid-Spanning Tree Protocol (RSTP).

.4 Device-Level Ring (DLR).

.5 Power over Ethernet (PoE).

.6 Power over Ethernet Plus (PoE+).

.7 Integral Modbus TCP server for monitoring switch status.

.8 Integral EtherNet/IP server for monitoring switch status.

.9 SNMP v 2.0 for monitoring switch status.

.3 Uplink ports:

.1 2 SFP sockets fitted with SFP modules providing single-mode gigabit fibre ports.

.4 Approved vendors:

.1 Hirschmann.
.2 Phoenix Contact.
.3 Cisco.
.4 Ntron.

.5 Power supply:

.1 24 VDC.

.6 Provide 120 VAC to 24 VDC power supply if 24 VDC power is not available at location. Note: Not applicable if power requirement is 120 VAC:

.1 Only DIN-rail mount power supplies are acceptable. “Wall-Wart” style power adapters are not acceptable.
.2 Approved vendors:
.1 Weidmuller PROmax Series.
.2 Phoenix Contact Quint Series.
.3 Or Engineer approved equivalent.

2.6 ETHERNET ROUTERS

.1 Provide routers in field panels per Drawings. Unless indicated otherwise in Drawings, routers to have:

.1 Firewall with fully configurable access rules to include port forwarding/ filtering/blocking.
.2 Network Address Translation (NAT).
.3 IPSec VPN Server and Client:
.1 IPsec NAT traversal.
.2 Encryption:
.1 Data Encryption Standard (DES).
.2 Triple Data Encryption Standard (3DES).
.3 Advanced Encryption Standard (AES) encryption:
.1 AES-128, AES-192, AES-256.
.4 Authentication (MD5/SHA1).
.4 Web configuration and firmware upgradeable using web interface.
.5 Minimum 2 LAN networks and one WAN network.
.6 Minimum 5 total Ethernet ports.
.1 Minimum 4 LAN-side Ethernet ports.

.2 Approved vendors:

.1 Cisco.

.2 Phoenix Contact mGuard series.

.3 Or Engineer approved equivalent.

Part 3 Execution

3.1 SYSTEM TOPOLOGY

.1 The network topology will be based on copper Ethernet and fibre Ethernet cabling in a star topology.

.2 DIN-rail mount Ethernet switches shall be installed in enclosures containing two or more IP-enabled pieces of equipment.

.3 IP-enabled equipment installed in an enclosure connects into the network at the field panels via RJ-45 ports on the Ethernet switch.

.4 Where wall-mounted RJ-45 jacks are shown, or where desktop workstations or printers are shown without a corresponding data port, a data port will be installed. Cable runs throughout the site to workstations, servers, and print servers shall be from wall mounted RJ-45 jacks to a central patch panel. All RJ-45 jacks located within the site shall be terminated at a patch panel. Individual connections made between the patch panel and the switch’s inputs shall be made with individual patch cables.

.5 Ensure multi-mode and single-mode cables are matched to the correct transmitters in all Ethernet equipment.

3.2 EQUIPMENT INSTALLATION

.1 Ensure that all Ethernet equipment is mounted to a DIN-rail, 19" rack, or to a panel wall.

.2 Ground Ethernet equipment in accordance with manufacturer’s recommendations.

3.3 CABLE INSTALLATION

.1 Within server rooms and data closets, as shown on Drawings, cables run on dedicated communications tray.

.2 Where dropped-ceilings are available, Ethernet cables can be run in above-ceiling space.

.3 In all other areas, including outdoors, Ethernet cables shall be installed in raceway in accordance with Division 26.

.4 No splices are permitted. If cables must be interconnected, patch panels must be used.

.5 Copper Ethernet cables must not share raceway with any other types of cabling.

.6 Fibre Ethernet cables may not share raceway with other types of cabling.

.7 Installation methods shall minimize tension and stress on Ethernet cables.

.1 Provide fibre-optic cable installation procedure for Consultant review prior to installation. Provide as a Shop Drawing.

3.4 SYSTEM TESTING

.1 Complete testing of each run of new copper Ethernet cabling installed using test equipment appropriate for the category of cable:

.1 Acceptable test equipment: Fluke MicroMapper or equivalent.

.2 Provide test report to Consultant prior to site acceptance test identified in Division 40 – Programmable Logic Controller and for inclusion into O&M.

.2 Provide in the test reports supporting information for test results of each link, including:

.1 Customer site.

.2 Identity of the link.

.3 Overall Pass/Fail evaluation.

.4 Cable type.

.5 Date and time of the test results.

.6 Brand name, model, and serial number of the tester.

.7 Revision software and the revision of the test standards database in the tester.

.8 Identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.

.9 Insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength and the margin (difference between the measured attenuation and the test limit value).

.10 Link length shall be reported for each optical fiber.

.3 Provide proof of test equipment calibration information for all equipment used to create test report.

3.5 DOCUMENTATION

.1 For each fibre optic or copper patch panel with more than one port, provide a paper patch panel schedule to be stored in the enclosure containing the patch panel. Schedule shall identify at minimum:

.1 Patch panel tag/identification.

.2 Terminated cable tag(s).

.3 Terminated cable destinations.

.4 Port numbers to which cables are terminated.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Any control panels, supplied as part of Owner-supplied systems, shall be installed, wired, tested and commissioned by the Contractor.

.2 The remaining control panels and modifications will be supplied, installed, wired, tested and commissioned by the Contractor.

.3 It is not the intent of this Specification to completely specify all details of design and construction.

.4 The selection of all accessories, Materials and methods of fabrication not specifically covered by these Specifications, but which are necessary to complete the fabrication of the Programmable Logic Control system shall be the responsibility of the Contractor and shall be carried out in accordance with good engineering practices.

.5 In case of conflict within this Specification or between the Specification, Drawings, purchase order and any other supplemental Specifications, the Contractor shall immediately submit the matter in writing to who shall make a determination and written clarification.

.6 The Contractor shall have full responsibility for adhering to all local Codes and local safety codes inspectors' requirements, such that there shall be no impact to project schedule.

.7 The Contractor shall have full responsibility for the supply, start-up and commissioning of the Programmable Logic Control system components.

1.2 SECTION INCLUDES

.1 Control/Interface panel requirements for:

.1 Programmable Logic Control.

.2 Ancillary interface equipment such as panels for VFDs, Soft starters, Motor starters, etc.

1.3 REFERENCES

.1 CAN/CSA 22.1, Canadian Electrical Code.

.2 C22.2 No. 14, Industrial Control Equipment.

.3 C22.2 No. 40, Conduit, Junction and Pull Boxes.

.4 C22.2 No. 94, Special Purpose Enclosures.

1.4 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures Division 01.

.2 Data to indicate system components, mounting method, source of power, and special attachments.

.3 Shop Drawings:

- .1 Submit sufficient information to demonstrate compliance with Drawings and Specifications in accordance with Division 01.
- .2 Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, wiring and connection diagrams, accessories, and nameplate data.
- .3 Include Shop Drawings for foundations and other support structures where required.
- .4 Product data:
  - .1 Include detailed information for components of the control panel:
    - .1 Wiring.
    - .2 Instrumentation.
    - .3 Switchgear.
    - .4 DC and AC disconnects.
    - .5 Factory testing results.

1.5 CLOSEOUT SUBMITTALS

.1 Submit, simultaneously with the Shop Drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts:

- .1 Safety precautions.
- .2 Operator restart.
- .3 Startup, shutdown, and post-shutdown procedures.
- .4 Normal operations.
- .5 Emergency operations.
- .6 Environmental conditions.
- .7 Preventive maintenance plan and schedule.
- .8 Troubleshooting guides and diagnostic techniques.
- .9 Wiring and control diagrams.
- .10 Maintenance and repair procedures.
- .11 Removal and replacement instructions.
- .12 Spare parts and supply list.
- .13 Parts identification.
- .14 Testing equipment and special tool information.
- .15 Configuration information.

.16 Communication mapping information.

.17 Warranty information.

.18 Testing and performance data.

.19 Contractor information.

Part 2 Products

2.1 GENERAL

.1 Assembled control panels and all internal components shall be CSA certified and a CSA or acceptable inspection lab tag shall be affixed to the front door of the enclosure.

2.2 CONSTRUCTION

.1 Unless otherwise indicated on the Drawings, control panels to be fabricated of steel, 14-gauge or 12-gauge, continuous welded.

.2 Steel enclosures to be powder coated RAL7032.

.3 Interior panels to be painted white:

.1 As required, cabinet to have side panel mounts pre-installed in factory for future installation or expansion.

.4 Doors:

.1 Doors to be equipped with rubber gaskets.

.2 Doors on wall-mounted enclosures to be secured by means of quarter-turn locking screws.

.3 Doors on floor-standing enclosures to be secured by means of locking handle.

.4 Provide 2 keys for each lock.

.5 Sized to accommodate specified control system equipment +20% spare.

.6 Wiring duct sized for specified instrument wiring +50% spare.

.7 Minimum 50 mm clearance between wiring duct and terminal strips (e.g., 50 mm clearance between where wire leaves wiring duct and point of termination on terminal strips).

.8 Wire and cable clamps to be:

.1 Mechanical fastener type; or

.2 Sticky pad type cable ties of type 3M Cable Tie Base 06291, Adhesive Mount, Ivory/ABS, 1″ × 2″.

.3 All surfaces to be prepared to manufacturer instructions.

.4 All defective mounts to be replaced with mechanical cable clamps.

.9 Fused terminals for all analog inputs, analog outputs, discrete inputs and discrete outputs.

.10 Control system equipment and HMI in top of panel, terminals in bottom of panel.

.11 Fluorescent light in top of panel capable of producing sufficient lighting inside panel.

.12 Minimum 18″ of space between fluorescent light and twisted copper ethernet wiring.

.13 Refer to Section 40 70 11 - Instrumentation Wiring for wire colour coding.

.14 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 AC Dandy.
.2 Hoffman.
.3 Rittal.
.4 Allen Bradley.
.5 Cooper B-Line.
.6 Approved equivalent.

2.3 FLOOR MOUNTED AND/OR WALL MOUNTED ENCLOSURE

.1 NEMA 4 for control panels located in the pump area (process area), unless enclosures models have been specified elsewhere.

.2 Minimum 12-gauge steel, or stainless steel, seams to be continuously welded and ground smooth with body stiffeners (as required), back panel supports, heavy duty hinges, heavy duty lifting eyes (as required), oil resistant door gasket, grounding stud on doors and body and painted ASA 61 Grey, or RAL7035 Beige powder coat epoxy paint.

.3 PVC acceptable for wall mounted panels.

.4 Floor mounted and free standing for large control panels, surface mounted for small enclosures.

.5 Single or double lockable doors with three-point latch and stainless steel handle, complete with keys.

.6 Solid cover, sides and bottom.

.7 Steel back panel(s) extending entire width of panel.

.8 Top hat cable entry box.

.9 Panel legs.

.10 Data pocket inside of door (large enough to accommodate 11 × 17 size Drawings).

.11 Folding shelf for floor mounted enclosures.

.12 LED light with lens and door switch, 1 for each door for floor mounted enclosures.

.13 120 VAC duplex receptacle mounted inside panel.

.14 Supplied complete with high density cable entry frame and modules.

.15 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Rittal.
.2 Hoffman.

2.4 HOUSEKEEPING PADS

.1 Provide minimum 100 mm cast concrete housekeeping pad, unless indicated otherwise on Drawings for:

.1 Floor-standing enclosures.

2.5 COMPONENTS - TERMINALS

.1 All terminals within a control panel shall be supplied from the same manufacturer.

.2 Unfused terminals to be CSA approved for 600 V, 10 A, accepting #12 AWG - #18 AWG wire, and coloured beige or grey:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Wieland WK4U.
.2 Weidmuller WDU4.
.3 Allen-Bradley 1492-W4.
.4 Phoenix Contact UK5N.
.5 Approved equivalent.

.3 Fused terminals to be CSA approved for 300 V, 10 A, with blown-fuse indicator operating on 120 VAC, accepting #10 AWG - #14 AWG wires, coloured beige or grey, and either 5 × 20 mm fuses or ¼" × 1¼" fuses, or both.

.4 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Wieland WK4/THSi6GL250U (Beige).
.2 Weidmuller WSI 6/LD (Beige).
.3 Allen-Bradley 1492H5 (Grey).
.4 Phoenix Contact UK5HESI (Grey).
.5 Approved equivalent.

.5 Knife-disconnect switch terminals to be CSA approved for 300 V, 10 A accepting #14 AWG wires, and coloured beige or grey:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Wieland WK4TKM/U.

.2 Weidmuller WTR4.
.3 Allen-Bradley 1492-JKD3.
.4 Phoenix Contact MTKP/P.
.5 Approved equivalent.

.6 Provide and install 10% spare terminals of each type used.

.7 Grounding terminals to be CSA approved for 300 V, 15 A, accepting #14 AWG wires, grounding to the rail, and coloured green and yellow:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:
.1 Wieland WK4SL/U.
.2 Weidmuller WPE 2.5.
.3 Allen-Bradley WG4.
.4 Phoenix Contact USLKG5.
.5 Approved equivalent.

.8 Insulated shorting bars to be used for jumpering lengths longer than 2 terminals.

.9 Wire jumpers are not acceptable unless specific approval is obtained from

2.6 COMPONENTS - FUSES

.1 All control fuses shall be installed such that easy removal is possible without disconnecting the incoming power or the use of special tools (i.e., insulated fuse holders).

2.7 COMPONENTS - PILOT LIGHTS

.1 Water and dust-proof with internal gasket, lens, colour as shown on Drawings, push-to-test style LED, bulb voltage 24 VDC/AC or 6.3 VAC.

.2 Include transformer where required for 120 VAC or 240 VAC operation:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:
.1 Eaton M22.
.2 Allen-Bradley 800F (22 mm).
.3 Allen-Bradley 800T (30 mm).
.4 Siemens Sirius ACT (22 mm).
.5 Siemens Sirius ACT (30 mm).
.6 Schneider Harmony (22 mm).
.7 Approved equivalent.

2.8 COMPONENTS - PUSH BUTTONS

.1 Water and dust-proof with internal gasket, flush head, contacts rated 5 A 120/240 VAC, accepting AWG 18-12 wires, removable contact blocks:

.1 Manufacturers: Subject to compliance with requirementsprovide products by the following:

.1 Eaton M22.

.2 Allen-Bradley 800F (22 mm).

.3 Allen-Bradley 800T (30 mm).

.4 Siemens Sirius ACT (22 mm).

.5 Siemens Sirius ACT (30 mm).

.6 Schneider Harmony (22 mm).

.7 Approved equivalent.

2.9 COMPONENTS - SELECTOR SWITCHES

.1 Manual selector switches to be water and dust-proof, with internal gasket, standard black lever actuator, maintained position unless indicated, contacts rated 5 A 120/240 VAC, accepting AWG 18-12 wires, removable contact blocks:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Eaton M22.

.2 Allen-Bradley 800F (22 mm).

.3 Allen-Bradley 800T (30 mm).

.4 Siemens Sirius ACT (22 mm).

.5 Siemens Sirius ACT (30 mm).

.6 Schneider Harmony (22 mm).

.7 Approved equivalent.

2.10 COMPONENTS - CONTROL RELAYS

.1 Control relays to be installed in socket, with built-in LED or neon operation indicator, push-to-operate button, coil voltage as required, CSA approved.

.2 Contacts to switch 5 A 120/240 VAC inductive or resistive.

.3 Operating time to be 20 mS max for AC coil, 30 mS max for DC coil.

.4 Life expectancy to be 100,000 operations @ 5 A 120/240 VAC:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Omron type G2R.

.2 Potter-Brumfield type KRPA.

.3 Weidmuller TRS24-230VUC 2CO (Universal coil).

.4 Approved equivalent.

2.11 COMPONENTS - TIME-DELAY RELAYS

.1 Time-delay relays to be installed in socket, with manually-adjustable timing via knob with dial, output status light, operating voltage as required, ON-delay or OFF-delay time as indicated, CSA approved.

.2 Contacts to switch 5 A 120/240 VAC inductive or resistive.

.3 Life expectancy to be 100,000 operations @ 2 A 120/240 VAC:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 OMRON type H3CA.

.2 OMRON type H3CR.

.3 Approved equivalent.

2.12 COMPONENTS - DC POWER SUPPLIES

.1 Power supplies with 24 VDC output for driving 4-20 mA analog loops to include over-voltage shutdown, 120 VAC input and CSA approval.

.2 Dual supplies to include redundancy modules to suit manufacturer.

.3 Output voltage to be adjustable +10% via screwdriver:

.1 Unless indicated otherwise in Drawings manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Weidmuller Connect Power series DIN rail mounted power supply.

.2 Phoenix Contact QUINT-PS series DIN rail mounted power supply.

.3 Approved equivalent.

2.13 COMPONENTS - SURGE ARRESTORS

.1 Surge arrestor to be able to operate in parallel or series with power system.

.2 Maximum surge current of 18 kA with 8/20 µs profile.

.3 Maximum continuous operating amps = 15 A in series, unlimited in parallel.

.4 Operating voltage of 120/140 V:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Eaton AEGIS Series.

.2 MTL Surge Technologies, MA15 Series.

.3 Sola HD.

.4 Weidmuller, MA15 Series.

.5 Approved equivalent.

2.14 CONTROLS CIRCUIT PROTECTION

.1 Fuses: Size as required and to be compatible for above terminal blocks and FIM modules. Maximum rating to be 80% of wire rating.

.2 Internal control panel breakers:

.1 DIN rail mounted.

.2 CSA certified as a branch breaker.

.3 Size as required, maximum rating to be 80% of load side wire rating.

.4 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Siemens.

.2 Schneider.

.3 Weidmuller.

.4 Approved equivalent.

2.15 COMPONENTS - UNINTERRUPTIBLE POWER SUPPLIES (UPS)

.1 Uninterruptible power supplies to be On-line1 type with integral bypass switch. Line Interactive or standby UPS are not permitted.

.2 Waveform to be true sine wave.

.3 1,500 VA minimum unless indicated otherwise in Drawings.

.4 Equipment to include relay contact output:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Eaton Powerware 9130 Series.

.2 Always On N Series.

.3 APC Smart-UPS On-Line Series.

.4 Approved equivalent.

2.16 CONTROL PANEL RECEPTACLE

.1 Din rail mounted.

.2 15 A Duplex:

.1 Manufacturers: Subject to compliance with requirements, provide products by the following:

.1 Weidmuller DRAC DP15.

.2 Approved equivalent.

[1]On-line type: The output power is always derived from the battery. The AC and DC relationship is as follows. Mains (AC) -> UPS Input (AC/DC)-> UPS Battery (DC) -> UPS Output (DC/AC) -> Device (AC). There is no direct power connection between the Mains or Device.

2.17 WIREWAYS

.1 Plastic wiring raceway with removable covers.

.2 Raceway shall be sized for 35% wire fill.

.3 Separate raceways shall be provided as follows:

- .1 24 VDC cabling.
- .2 120 VAC cabling.
- .3 Power cabling.
- .4 Communication cabling.
- .5 Manufacturers: Subject to compliance with requirements, provide products by the following:
  - .1 Panduit.
  - .2 Approved equivalent.

2.18 HIGH DENSITY CABLE ENTRY FRAMES

.1 Cable entry frame for entry of TECK armoured or pre-terminated cables into enclosure.

.2 Supplied complete with grounded modules BG Seriesfor entry of TECK armoured cables.

.3 Bonded to enclosure ground bar.

.4 Manufacturers: Subject to compliance with requirements, provide products by the following

- .1 Roxtec.
- .2 Approved equivalent.

2.19 GROUNDING

.1 Provided grounding lug, suitable for termination of #2/0 to #4/0 copper grounding cable.

.2 Separate grounding bars are to be provided for power grounds and instrument control system grounds (signal cable grounding, etc.).

.3 Provide electrical isolation mounts for instrument ground bar with dedicated ground connection to main system ground bus.

2.20 LABELLING

.1 Label all terminals, wires and cables in accordance with Section 26 05 00 - Common Work Results Electrical and Section 40 70 10 - Instrumentation General.

.2 Terminal labels to be black text on white background.

.3 Label all internal control panel components with a lamicoid label. Minimum text size to be 5 mm high.

.4 Terminals shall be grouped for clarity and a lamicoid label provided for each group.

.5 Label the front of the control panel in accordance with Section 26 05 00 - Common Work Results Electrical.

.6 WRITE ON LABELS ARE NOT ACCEPTABLE.

.7 Wire labels to be PVC material with black text on white background, securely fastened to prevent movement on wire or cable:

.1 Manufacturers: Subject to compliance with requirements, :

.1 Weidmuller Type Z.

.2 Wieland type Z5.

.3 Approved equivalent.

2.21 ACCESSORIES

.1 DIN rail mounted fuse tester for each control panel.

.2 DIN rail mounted fuse storage container for each control panel.

2.22 WIRE TYPE AND COLOURS

.1 All wiring shall be colour coded according to the Owner's standards as shown below:

.1 120 VAC power cable: Black = Hot, White = Neutral Green = Ground (if insulated single conductor.

.2 12/24 VDC power cable: Red = Positive, Black = Negative.

.3 Analog cable - White = Positive, Black = Negative, Clear: Shield shrink.

.4 DI 24 VDC/120 VAC Signal Cable:

.1 For multi-conductor cable: Black.

.2 For single pair cable: White = Hot, Black = Return.

.5 DO 24 VDC/120 VAC signal cable:

.1 For multi-conductor cable: Black.

.2 For single pair cable: White = Hot, Black = Return.

.2 Internal control panel wiring for 120 VAC power distribution circuits:

.1 Rated No. 14 AWG, 600 V PVC type insulation rated for -40°C to +105°C, CSA rating TR-32, UL Style 1015, tinned, stranded copper conductor.

.3 Internal control panel wiring for PLC Control 120 VAC discrete signals:

.1 Maximum 15 A circuit protection.

.2 Rated No. 14 AWG, 600 V PVC type insulation rated for -40°C to +105°C, CSA rating TR-32, UL Style 1015, tinned, stranded copper conductor.

.4 Internal control panel wiring control 24 VDC analog signals:

.1 Maximum 1 A circuit protection.

.2 Stranded No. 18 AWG tinned copper conductors, 300 V with individual shielded twisted pairs. Use Belden Type 9318 for cables requiring 1 pair of individually shielded twisted pairs, Belden 9368 for cables requiring 2 pairs of individually shielded twisted pairs, and Belden 9388 for cables requiring 4 pairs of individually shielded twisted pairs.

2.23 SPARE PARTS

.1 Supply 5 spare fuses for each fuse.

.2 Supply spare fuses in din rail mounted fuse compartment.

Part 3 Execution

3.1 GENERAL

.1 Field measure all backplate and devices to be relocated. Advise of changes by submitting modified panel layout drawing.

.2 All AC and DC wiring shall be run in separate raceways.

.3 Provide separate #6 ground to main building ground, for each DC ground bus.

.4 Install a maximum of 1 wire per terminal side.

.5 Install terminal cross connects or combs where required. Do not install jumper wires.

.6 Wire power supply contacts to PLC system. Provide relays, if required.

3.2 INSPECTION AND TESTING

.1 Field measure all backplate and devices to be located.

.2 Advise of changes by submitting modified panel layout drawing.

.3 The Consultantreserve the right to inspect and witness test the control panels before shipment to site through a formal Factory Acceptance Test (FAT) procedure. The

3.3 PACKAGING AND SHIPPING

.1 The panels shall be prepared for shipment so as to protect them from physical damage. Assemblies shall be packaged in generously padded cartons or containers. Partial shipment shall only be allowed by written approval of the

.2 All shelf-mounted instrumentation shall be removed from the panel before shipment and repackaged in its original containers for shipment to the job site.

.3 Any other loose components shall be taped or tied down, and/or supported with polyurethane foam so as to provide a tight, vibration free shipping unit.

.4 In addition to the Owner's company name and the shipping destination, the outside of each crate or carton shall be marked with the Purchase Order and Item Number(s). A label listing contents and a duplicate listing shall be included inside the package.

3.4 PAINTING

.1 Painted or power-coated surfaces on material supplied or installed under this Contract, which are damaged in any way, i.e., by welding, scraping, cutting, etc., to be thoroughly cleaned, primed with a rust inhibiting primer and repainted to the original colour.

.2 Penetration holes or cut-outs are to be painted.

.3 The finished product to meet or exceed the original Painting Specification.

3.5 CHANGES DURING DESIGN

.1 The shall reserve the right to change and modify the following items prior to submitting reviewed Shop Drawings to the Contractor at no additional cost.

.2 The following items shall not constitute a change to the Contractor's scope of supply:

.1 Equipment names and descriptors and associated equipment nameplates.

.2 Wire and cable nomenclature for Drawings and physical markers.

.3 Terminal block nomenclature for Drawings and physical labels.

.4 Equipment location - providing only that the change is requested before installation and that the new location is within 3.0 m of the original location.

3.6 CLEANUP

.1 Progress cleaning: Clean in accordance with Division 01.

.1 During the progress of the Work, the Contractor shall remove from the building site rubbish, dirt and other debris caused by performance of the Work.

.2 Leave Work area clean at end of each day.

.2 Final cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01.

.3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Three (3) existing high lift potable water pumps at the water treatment plant will be replaced in a phase approach. The existing pumps are at the end of their service life, and the proposed new pumps are to match the existing pump curves.

.2 The scope of this 2025 Work Program is the replacement of one (1) of the existing high lift pumps, HLP-1, with a new VFD and new power control panel.

.3 The pumps will have variable modes of operation, (i.e. speed control, pressure control, etc..)

1.2 SCOPE

.1 This Section refers to the design, manufacture, assembly, shop testing, supply, transport to site, coordination with Contractor, site testing, commissioning, electric motors, appurtenances, special tools, and equipment as specified.

.2 The equipment shall be supplied to the Contractor for installation.

.3 Shop drawings shall be supplied to The City through the Engineer for review prior to a General Contractor being selected. Copies of reviewed Shop Drawings shall be supplied to the Contractor once they have been selected.

.4 The tag numbers for the required pump is:

Tag Number	Operation
HLP-1	Electrically driven pump for operation with Variable Frequency Drive (VFD).

1.3 STANDARDS

.1 All Work to be completed to the following latest applicable standards at the time of bidding except where a higher standard is specified:

.1 American Water Works Association (AWWA).
.2 Hydraulic Institute (HI) Standards.
.3 American Society for Testing Materials (ASTM).
.4 American Society of Mechanical Engineers (ASME).
.5 Canadian Standards Association (CSA).
.6 American Institute of Electrical Engineers (AIEE).
.7 National Electric Manufacturers Association (NEMA).
.8 Institute of Electrical and Electronics Engineers (IEEE).
.9 International Electrotechnical Commission (IEC).
.10 Canadian General Standards Board (CGSB).
.11 Canadian Electrical Code.
.12 Antifriction Bearing Manufacturers Association (AFBMA).

.13 American Gear Manufacturers Association (AGMA).

.2 Material Standards: Unless otherwise specified herein, all materials and equipment will conform to the standard specifications of the American Society for Testing Materials, referred to as the ASTM Standards, or the equivalent European standard as defined by EN 10027, except where a higher standard is specifically called for herein.

.3 Mechanical Standards: The mechanical features of the equipment covered by this Specification will conform to the standardization rules of the American Society of Mechanical Engineers (ASME), Hydraulic Institute Standards, and Hydraulic Institute Engineering data book, except where a higher standard is specifically called for herein.

.4 Electrical Standards: Electrical equipment covered by these Technical Specifications to comply in all respects with the requirements of the standardization rules of the NEMA Standards, except where a higher standard is specifically called for herein.

.5 Electrical equipment must be CSA approved.

.6 Pumps covered under this section shall be certified to NSF 61 Annex G (NSF 61-G) and therefore comply with both NSF 61: Drinking Water System Components – Health Effects and NSF 372: Drinking Water System Components – Lead Content.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Equipment dimensional drawings: pdf and AutoCAD or .dxf file format including:

.1 Outline and general arrangements.

.2 Plans.

.3 Sections.

.4 Details.

.3 Operating and Maintenance Data, as specified in Section 01 78 23.

.4 The manufacturer’s specifications for all equipment supplied.

.5 Pump product data to include the following:

.1 Manufacturer.

.2 Location of manufacture.

.3 Model number or type.

.4 Rotational speed (rpm).

.5 Performance curves with the following information through the full operating range of pump from shutoff to run-out:

.1 Head (m).

.2 TDH (m)

.3 Capacity (ML/d).

.4 Efficiency.

.5 Flow rate at Best Efficiency Point

.6 Net positive suction head required (m).

.7 Shaft power (kW).

.8 Allowable Operating Range (AOR)

.9 Preferred Operating Range (POR)

.6 Minimum continuous rated flow (ML/d).

.7 Shutoff head.

.8 Wire-to-water efficiency for the motor driven scenario at guarantee point and full speed.

.9 Specific speed calculations.

.10 Impeller diameter at specified guarantee point (mm).

.11 Trimmed and maximum impeller diameter (mm).

.12 Details of shaft seal arrangement.

.13 Motor load, efficiency, speed, torque, current and power factor curves and data based on Project Site elevation.

.14 Anchor bolt design.

.15 Allowable nozzle loads.

.16 Pump torque-speed curves for pump start-up against both an open and closed discharge valve.

.17 Mass moment inertia of rotating parts of pump ($kg \cdot m^2$).

.18 Total mass of pump (kg).

.19 Materials, including relevant standards, used in construction of pump for each including but not limited to the following:

.1 Castings.

.2 Bolting.

.3 Impeller.

.4 Bearings (for each component).

.5 Pump shaft.

.6 Coating and lining (for each component).

.7 Flanges.

.8 Seals.

.9 Couplings.

.20 Torsional vibration analysis results.

.21 Base construction and layout, including anchor bolt spacing.

.22 Control I/O listing, signal type, and make/model of instrumentation.

.1 At minimum include the following and provide list of any other options

.1 Remote status

.2 Valve control block status

.3 Run status

.4 Shaft Speed

.23 Any additional information required by The Engineer.

.6 Motor data to include the following:

.1 Manufacturer.

.2 Location of manufacture.

.3 Model No. or type.

.4 Synchronous speed and full load speed.

.5 Total mass of motor (kg).

.6 Name and contact information of manufacturer's closest service facility.

.7 Manufacturer of stator coils and rotor coils.

.8 Location of motor testing.

.9 Nameplate:

- .1 Shaft power kW at full load (100% load).
- .2 Insulation class.
- .3 Service factor.
- .4 Frequency.
- .5 Terminal voltage.
- .6 Type, torque speed characteristics.
- .7 Code, locked motor kVA.
- .8 Frame.
- .9 Phase.
- .10 Temperature rise (°C):
  - .1 At full load.
  - .2 At service factor load.
- .11 Maximum ambient temperature (°C).
- .12 Full load amps.
- .13 Full load speed.
- .14 Motor natural torsional and lateral frequencies

.10 Performance:

- .1 Motor efficiency from 125% load to 50% load.
- .2 Power factor from 125% load to no load.
- .3 Starting performance at various voltages and loads requested by The Engineer.
- .4 Speed torque at 100% Voltage:
  - .1 Locked rotor, % Torque, Torque (N-m) and Amperes.
  - .2 Pull up speed (rpm), % Torque, Torque (N-m) and Amperes.
  - .3 Breakdown speed (rpm), % Torque, Torque (N-m) and Amperes.
  - .4 Full load speed (rpm), % Torque, Torque (N-m) and Amperes.
- .5 Complete speed/torque curves.
- .6 Acceleration time current and thermal unit curves at various voltages and load requested by The Engineer. Provide thermal curves for hot and cold motor starting for the total combined pump and motor inertial load.
- .7 Allowable start frequency for the total combined pump and motor inertia.

.11 Mass moment of inertia ($kg \cdot m^2$).

.12 Temperature sensor data with alarm and shutdown limits.

.13 Cooling airflow and total heat rejection.

.14 Overall dimensions of the motor.

.15 Shaft diameter and keyway and coupling dimensions and details.

.16 Fixing support dimensions.

.17 Power terminal box location and size of terminals and box(es).

.18 Auxiliary terminal box location and size of terminals and box(es).

.19 Arrangement and dimensions of accessories.

.20 Connection diagram.

.21 Starting in-rush current and code letter.

.22 Installation data.

.23 Wiring schematics.

.24 Pump baseplate FEA study:

.1 Campbell/interference diagram to determine if base plate natural mode fall within trouble frequencies.

.25 Vibration sensor data with alarm and shutdown limits.

.26 Bearing type and lubrication specifications.

.27 Terminal box wiring diagram.

.28 Proposed materials, routing and locations of sensor wiring, conduits, raceways, fastener and supports to be installed on site.

.29 Any additional information required by the Engineer.

.7 The Supplier shall provide, with Shop Drawings, full instructions of all precautions to be observed in association with the handling, storage and protection of the equipment.

1.5 OPERATING AND MAINTENANCE DATA

.1 Supply one searchable pdf set of operating and maintenance data for inclusion in the General Contractor supplied Operations and Maintenance Manuals in accordance with Division 01.

.2 Data to include:

.1 Manufacturer’s name, type, model, year, rated performance data, tag number and serial number for each:

.1 Pumping unit.

.2 Motor driver.

.3 Supplied instruments.

.2 Details of operation, service and maintenance.

.3 Details of accessories and instrumentation supplied with pumps and drivers.

.4 Set of final (“Reviewed” or revised by Supplier based on “Reviewed as Noted” comments) Shop Drawings.

.5 Original catalogue pump curve – clearly labelled ‘Catalogue Pump Performance Curve – Not Factory Tested Performance’.

.6 Certified shop test pump curve, test results and report for each pump clearly labelled 'Factory Tested Performance' with the equipment tag number.

.7 Certified shop test motor performance curves, test results and report for each pump motor clearly labelled with the pump/motor equipment tag number.

.8 Certified field test pump curves, test results and report.

.9 Recommended spare parts list for pumps, and motors with names, telephone numbers, website addresses and physical addresses of suppliers.

.10 Recommended protection sensor set points.

1.6 SPARE PARTS

.1 Provide spare parts recommended by the equipment manufacturers to support (continuous) operation of all equipment for a 2 year period.

.2 Provide special tools required for maintenance and repair of equipment.

.3 Provide itemized costs for all recommended equipment spare parts.

.4 Provide the following spare parts for each unique pump model supplied:

.1 One set of mechanical seals.

.2 One set of all bearing assemblies.

.3 One set of all pump gaskets.

1.7 WATER QUALITY

.1 The water to be pumped is potable water.

1.8 ROTATION

.1 The direction of rotation of the shaft shall be as required by the manufacturer.

1.9 FACTORY INSPECTION AND WITNESS TESTING

.1 The Engineer has the right to inspect the Work during all stages of production, construction, and testing, whether at the manufacturer's own factories or those of other parties supplying other materials, parts or services for the equipment.

.2 Factory testing shall be virtually witnessed by the City's representatives for each unit supplied. The Supplier shall supply a projected test schedule and testing procedure at least one (1) month in advance of the test date. All units shall be complete, pre-tested and available on the date of witness testing at the factory.

Part 2 Products

2.1 HORIZONTAL SPLIT CASE PUMPS

.1 General:

.1 The pumps are to be single stage, horizontally mounted, axially-split centrifugal pumps.

.2 The pumps are to replace existing dual coupled electric drive pumps located in the City of Kenora, Water Treatment Plant. The pumps shall be configured and meet the space constraints as shown on the Drawings.

.3 Serial numbers and nameplates:

.1 Pumps, and motors, are separately identified by tag numbers as provided on the Drawings and Technical Specifications.

.2 Stamp each piece of equipment with a serial number, prior to shop performance testing.

.3 Provide each piece of equipment with stainless steel nameplates attached to the unit, clearly inscribed with the following:

.1 Manufacturer's name.

.2 Year of manufacture.

.3 Principal rating data.

.4 Capacity at the design duty point (guarantee point) in ML/d.

.5 Total dynamic head at guarantee point in metres.

.6 Impeller trim diameter in millimetres.

.7 Rotational speed in rpm.

.8 Direction of rotation using an arrow and "cw" or "ccw".

.9 Pump tag number.

.2 System Description:

.1 Pumps HLP-1, HLP-2 and HLP-3 are High lift pumps are feeding a local pressure zone and also filling a standpipe in the distribution, the pump operation is normally based on a start-stop filling based on water level in the standpipe. The pump will be adjusted to a set flow rate (speed set point) in an on/off duty operation. In the event the standpipe is offline, the pump can operation in an alternative constant pressure mode.

.1 As the Zone 1 Standpipe hits a low water level setpoint, the duty high lift pump is turned on to start filling the standpipe (and re-pressurize the distribution system). When the standpipe is full at the high-water level, the high lift pump(s) are turned off. There is also a second low level setpoint in the standpipe to trigger the lag pump to help with filling.

.3 Operation:

.1 The high lift pumps operate in a lead-lag mode with all three pumps alternating duty as a constant feed pumps. The pumps on a variable speed drive allows it the flexibility to not only dial in a flow objective, but it can also maintain a desired pressure operation in the event the standpipe is offline and the WTP feeds the distribution directly. Since the objective of the pumps is to re-fill the Zone 1 standpipe, the pump operates at a constant feed duty point of ~150 L/s at 80 psi.

.4 Pump Casing:

.1 The pump casing shall be made of ductile iron ASTM A48/EN 1561.

.2 The suction and discharge nozzles shall be provided with integrally cast flanges to ANSI/ASME B16.1.

.1 Pumping unit flange pressure ratings are as shown on the datasheets.

.3 Each casing shall be made in two halves and split along the horizontal axis at the pump shaft.

.4 The pump casing to have NPT tapped openings for air relief, seal water supply and drain connections. All openings to be supplied with threaded plugs.

.5 Provide minimum 15 mm diameter tapped connections on the suction and discharge flange connections of the pump for temporary installation of pressure gauges.

.6 Seal flush piping connected to the pump casing, shall be stainless steel tubing suitable for the pressure rating and flow rate required and to NSF 61-G.

.5 Impeller:

.1 The pump impeller shall be made of 316 stainless steel material.

.2 The impeller shall be of the enclosed type.

.3 The impeller trim shall have a diameter of not more than 95% of the full-size impeller.

.4 Dynamic balance of the impeller and rotating assembly to ISO 1940-1 Grade G 2.5.

.6 Wearing Rings:

.1 The pump is to be equipped with removable wearing rings on the impeller and casing. Minimum wear ring hardness difference between the impeller and casing of at least 50 Brinell hardness number.

.2 Materials to be 316 stainless steel.

.7 Bearings:

.1 Radial bearings shall be of the self-aligning sleeve type or extra heavy duty self-aligning anti-friction type. Sleeve bearings shall be ring greased and split along the centre lines. Anti-friction bearings shall be S.K.F. Suitable thrust bearings shall be provided on the pump. Bearings shall be designed for minimum L10 life of 100,000 hours in accordance with ABMA ratings.

.8 Shaft:

.1 Pump shaft to be made of 416 stainless steel, ASTM A582.

.9 Coupling:

.1 Alignment requirements for the pump and motor shafts, as well as allowable limits for the coupling are to be identified in the submittals.

.2 Coupling to be rated for continuous duty at a minimum of 20% greater than the motor horsepower.

.3 Coupling steel material: Grade 304 stainless steel.

.4 Flexible coupling for connection of the pump and motor shafts

.10 Shaft Seal:

.1 Pumps shall be supplied complete with split type mechanical seals with manufacturer's standard materials that meet the pump manufacturer's performance specification.

.1 Approved products: Chesterton ® 442, split type mechanical seal.

.2 The normal operating limits on the inside seal shall be 150% of the maximum pump pressure.

.3 Seal flushing shall be in accordance with API flush plan 11. Seal chamber water will be piped to mechanical seal.

.4 Materials of construction for mechanical seals shall be equivalent to, or more resistant grade than the following:

.1 All metal parts: 316 S.S.

.2 Rotary face: silicon carbide.

.3 Stationary face: carbon.

.4 Set screws: 316 S.S.

.5 O-rings: Viton.

.6 Springs: Hastelloy C.

.5 All seals should be able to be removed without unbolting the pump, coupling, pump casing top half, or the driver.

.11 Lining:

.1 Pump casing to be lined with NSF 61 listed, smooth finish epoxy coating.

.2 Coating thickness as required for the applicable NSF61 certification.

.3 Coating material to be hydrophobic, to encourage high pumping efficiency.

.12 Equipment Anchor Bolt Assemblies and Base frame:

.1 A structural steel common baseplate/base frame is to be provided for mounting the pump and motor designed in accordance with the results of a torsional vibration analysis.

.2 Provide bolt loads and size. Bolts are to be to ASTM A490 high strength bolts and stamped accordingly.

.3 Number, size, and location of anchor bolts are be determined by the Supplier and identified in the initial Shop Drawings submission.

.4 Provide lugs for anchor rods, and ports to facilitate grouting if baseframe is enclosed.

.5 Baseframe is to be coated for corrosion protection and specifically coated on the baseplate bottom with a temporary coating to be removed prior to installation to promote grout adhesion to bare steel.

.6 Each pump and motor to be provided with standard taper dowels with pulling nuts. The dowels to be inserted after installation to ensure proper re-alignment when the units are disassembled.

.7 Provide adjustment lugs for the motor. The lugs shall be attached to the base frame and drilled and tapped for a fine thread screw to permit micrometre, two-direction, horizontal adjustment of the pump or motor. Provide the fine threaded screws.

.8 Pump and motor baseframe to be provided with machined plates at pump and motor supports with all machined faces in the same plane.

.9 Provide baseframe suitable for grout filling. Provide grout holes, vent holes and anchor rod holes in the baseframe.

.10 Provide templates to locate anchor rods.

.13 Exterior Coating:

.1 Primer to , primer, marine for steel:

.1 Primer for second coat: Tinted sufficiently off finish colour of first coat to show where second coat is applied.

.2 Tinting material: Compatible with primer and not detrimental to its service life.

.2 Enamel to CAN/CGSB 1.61, enamel, alkyd, marine, exterior; colours as noted in following table:

.1 Paint colours are as follows:

Pumps	RAL 5002 (ultramarine blue)
Motors	RAL 7004 (signal grey)
Machine Bases	RAL 7004 (signal grey)
Pump Guards	RAL 3020 (traffic red)

.14 Vibration, Temperature, and Speed Monitoring:

.1 Vibration Monitoring:

.1 To be factory installed.

.2 Vibration monitoring will be used for equipment protection purposes.

.3 Vibration transmitters will be connected to PLC remote I/O cabinet.

.2 Provide 2 vibration transmitters for each pump bearing. At each pump end, one transmitter to measure X-axis vibration, and the other to measure Y axis vibration.

.1 Select appropriate accelerometer/velocity sensitivity, and whether measuring peak or RMS values; also select appropriate frequency range and filtering, all according to Hydraulic Institute Standards for alarming and shutdown.

.2 Transmitters shall produce a 4-20 mA signal, loop powered from 24 VDC.

.3 Mechanical connection: ¼’x 28 transmitter stud fitted to a suitable mounting hole tapped in the bearing housing.

.4 Electrical connection shall be armoured flying leads of sufficient length and properly routed to terminate in pump’s instrument connection box.

.5 Approved product: IMI Sensors model 649A04 or similar product from same manufacturer to meet selection criteria in item 1.

.3 Temperature Sensors:

.1 Provide single 3-wire sensor, 100 Ohm platinum at 0°C temperature sensitive devices, class B accuracy RTD's, in each pump bearing, terminated in pump’s instrument connection box.

.2 Each RTD will include lead wire for factory termination to a pump mounted terminal box.

.3 All exposed leads are to be mechanically protected within flexible metallic or rigid conduit. Leads are to be sufficiently long.

.4 Speed Sensor:

.1 Provide pump shaft speed sensor/transmitter.

.2 Instrument shall produce a 4-20 mA signal, loop powered from 24 Vdc.

.3 Speed sensor shall be factory installed.

2.2 ELECTRIC MOTORS FOR HORIZONTAL CENTRIFUGAL PUMPS

.1 The motors shall be suitable for horizontal centrifugal pump application as specified.

.2 The motors shall be mounted on a baseplate common with the driven unit. Each motor shall be horizontal, squirrel cage induction type, inverter duty according to NEMA MG-1 Part 31.

.3 The motor supports shall be machine finished and all in the same plane.

.4 Performance requirements specific to individual pump motors are given in the Equipment Data Sheets at the end of this section.

.5 Motors shall be NEMA Premium Efficiency type as specified in the Equipment Data Sheets and in accordance with CSA C390 M1985 or IEEE 112 standards. Motors shall be CSA labelled.

.6 Current:

.1 The motor shall conform to NEMA MG-1 Design B characteristics for normal torque.

.2 The motor shall be suitable for “Across-the-Line” starting.

.7 Rating:

.1 The motor shall operate at the speed and rating for which it has been designed. The rating of the motor shall not be exceeded under any pump operating condition between shut-in and the minimum operating head. In all cases, the motor rating shall not be less than specified.

.2 Voltage rating shall be 4000 V, 60 Hz

.8 Winding temperature increase shall not exceed 90°C at 1.15 SF, by resistance method.

.9 Motor shall be designed for 40°C ambient.

.10 Insulation:

.1 The insulation shall be Class F per NEMA MG-1.

.11 Starting Conditions:

.1 The motors shall be suitable for the number of starts indicated in the data sheet.

.12 Motor Noise Levels:

.1 The motor shall be specially designed for quiet operation at all sound frequencies:

.1 The overall sound pressure level for the motor shall not exceed 75 dB when measured per NEMA MG1 – Part 9.

.13 Terminals and Conduit Boxes:

.1 The motor shall be provided with terminals and conduit boxes on the side of the frame:

.1 All leads shall be of sufficient length and supplied with approved type solderless lugs for external cable connections.

.2 Locate motor terminal box as shown on the Drawings and confirmed by The Engineer during the Shop Drawing review.

.3 The terminal boxes will be located to maximize the clearance between motors on adjacent pumps.

.4 Threaded connections to be suitable for North American market.

.5 Provide auxiliary/instrument terminal box sized to accommodate motor instrumentation and auxiliary cable connections on each motor housing.

.6 Terminal boxes to be of ample size with at least 4 spare terminals.

.14 Shafts:

.1 The motor shaft shall be of high tensile, rolled steel, turned all over, and designed with an ample margin for all stresses.

.15 Bearings:

.1 The bearings for the motors shall be self-aligning extra heavy-duty antifriction type, S.K.F. designed and constructed to provide minimum L10 life of 100,000 hours as per ABMA ratings.

.2 The bearings shall be so designed that no oil or grease can escape from them.

.16 Frame and Dimensions:

.1 The frame shall conform to NEMA MG1 Standards.

.17 Vibration and Temperature Monitoring:

.1 Vibration Monitoring:

.1 To be factory installed.

.2 Vibration monitoring will be used for condition monitoring and protection purposes.

.3 Vibration transmitters will be connected to PLC remote I/O cabinet.

.2 Provide 2 vibration transmitters for each motor bearing. At each motor end, one transmitter to measure X-axis vibration, and the other to measure Y axis vibration.

.1 Select appropriate accelerometer/velocity sensitivity, and whether measuring peak or RMS values; also select appropriate frequency range and filtering, all according to Hydraulic Institute Standards for alarming and shutdown.

.2 Transmitters shall produce a 4-20 mA signal, loop powered from 24 Vdc.

.3 Mechanical connection: ¼’x 28 transmitter stud fitted to a suitable mounting hole tapped in the bearing housing.

.4 Electrical connection shall be armoured flying leads of sufficient length and properly routed to terminate in motor’s instrument connection box.

.5 Approved product: IMI Sensors model 649A04 or similar product from same manufacturer to meet selection criteria in item 1.

.3 Temperature Sensors:

.1 Provide single 3-wire sensor, 100 Ohm platinum at 0°C temperature sensitive devices, class B accuracy, RTD's, stator mounted, two per phase, terminated in motor's instrument connection box. Final wiring connection to GE Multilin motor protection unit (by others).

.2 Provide single 3-wire sensor, 100 Ohm platinum at 0°C temperature sensitive devices, class B accuracy RTD's, in each motor bearing, terminated in motor's instrument connection box.

.3 Each RTD will include lead wire for factory termination to a motor mounted terminal box.

.4 All exposed leads are to be mechanically protected within flexible metallic or rigid conduit. Leads are to be sufficiently long, and include pin-type connectors at sensor to allow for device removal without requiring electrical disconnection.

.4 Sensor and Motor Space Heater Cabling/Leads:

.1 Mechanically fasten to equipment with metal cable snap clips, if required. Sticky pads are not acceptable.

.18 Approved Product:

.1 US Motor

.2 WEG

.3 Toshiba

2.3 GUARDS AND LUBRICATION ACCESSORIES

.1 Provide guards for exposed drives. Guards to completely surround coupling shafts as per OH&S requirements.

.2 Coupling guard to meet the requirements of CSA Z432 Safeguarding of Machinery.

.3 Guards for drives to have:

.1 Expanded metal screen welded to 25 mm steel angle frame.

.2 18 Ga. galvanized sheet metal tops and bottoms.

.3 Removable sides for servicing.

.4 40 mm diameter holes (in guard) on both shaft centres for insertion of a tachometer.

.5 Guards shall be painted safety red.

.4 Secure guards to driven machine, foundations or floors with heavy angle supports and anchor bolts.

.5 Do not short circuit vibration isolators.

.6 Provide means to permit lubrication, use of speed counters, or other maintenance and testing operations, with the guard in place.

.7 Provide protective screen on both inlet and outlet of exposed fan blades. Screen to be fabricated from 20 mm mesh minimum galvanized expanded metal such that the net free area of openings is not less than 80% of the original opening.

.8 Lubrication, provide either of the following:

.1 Provide automatic, oil reservoirs (with transparent reservoir) to provide constant oil application for each bearing on the pump and motor. These reservoirs are to be fully accessible and visible. Submit details as part of the Shop Drawings.

.2 Provide grease filled anti-friction bearings and prescriptive details on maintenance interval and re-greasing requirements.

2.4 PUMP AND MOTOR DATA SHEET

Equipment Tag Numbers:	HLP-1
Quantity:	1
Pump Elevation	321.03 m above mean sea level
Performance (each pump)	
Duty Point:	150 L/s at 64 m TDH
NPSHa @ 150 L/s	6.0 m
Minimum Acceptable Pump Efficiency at Guarantee Point	80%
Minimum Shut-off Head:	68.42 m
Construction	
Pump Flange rating:	ANSI/ASME B16.1 Class 125
Normal Discharge Pressure:	627 kPa (91 psi) at discharge of pump
Design Discharge Pressure:	1.5 times shut-off head + suction head
Nominal Discharge Diameter:	Discharge Nozzle Size by Supplier Discharge Header: 200 mm
Nominal Suction Diameter:	250 mm
Motor	
Type:	NEMA Premium Efficiency Inverter Duty per MG-1, Part 31, Squirrel Cage Electric Induction Motor
Power:	By Supplier
Electric Power Supply:	575 V, 3-phase, 60 Hz
Maximum Speed:	1800 rpm (nominal)
Service Factor:	1.15

Starts/hour:	2 minimum
Motor Type:	Horizontal
Insulation:	Class F or higher
Ambient Temperature	0-40°C
Temperature Rise at SF (ambient at 40°C):	90°C
Enclosure:	WP1
Maximum kVA Starting Code:	F or lower
Space heater require: Voltage	Yes, 120 V

2.5 APPROVED PUMP SUPPLIERS

.1 Peerless (Model: 6AE16)

.2 Aurora (base bid)

.3 Flowserve

.4

.5 Goulds (base bid)

Part 3 Execution

3.1 TORSIONAL VIBRATION ANALYSIS

.1 The pump manufacturer shall determine the potential for a critical torsional natural frequency occurring within the normal operating speed range of the pump.

.1 A Level 2 torsional dynamic analysis shall be performed in accordance with ANSI/HI 9.6.8 Rotodynamic Pumps Guideline for Dynamics of Pumping Machinery, Table 9.6.8.4.

.2 Standard calculations shall be performed using established equations in accordance with Section 9.6.8.5.6 to calculate a value for the torsional critical speed of the pump and motor, and pump and base frame as a system. The minimum frequency separation margin obtained by analysis shall be ±25%.

.2 Furnish analysis report to the Engineer with the results and conclusions of the vibration analysis. Report shall be in accordance with Appendix G of the ANSI/HI 9.6.8 standard.

3.2 HYDROSTATIC SHOP TESTS

.1 Each pump shall be subject to a hydrostatic test in accordance with the ANSI/HI 14.6, except that test pressures shall be at least 1.5 times the sum of the shut-off head and the maximum suction head.

.2 A certified test record in accordance with ANSI/HI 14.6 for each pump shall be submitted to the Engineer for review.

3.3 SHOP PERFORMANCE TESTS

.1 General:

.1 The pump and motor shall be subjected to separate shop performance tests as specified herein. The pump tests will be certified by the manufacturer's Engineer.

.2 The pump tests will be witnessed remotely through videoconferencing by The Engineer.

.3 The tests are intended to confirm compliance with the Specifications. Additionally, the tests shall determine the following:

.1 Pump flow and head capacities from shutoff to runout.

.2 Pump efficiency from shutoff to runout.

.3 Motor efficiency from shutoff to runout.

.4 Brake horsepower from shutoff to runout.

.5 Wire-to-water efficiency.

.6 Pump bearing temperatures.

.7 Pump bearing vibration levels.

.8 Net positive suction head required (NPSHr)

.9 All at the guarantee point rated head load, each of which shall be verified in the shop performance tests.

.4 All testing to be completed at a minimum of 8 points including one at each end of the operating range, and one at the guarantee point.

.5 Furnish all power, labor, materials and properly calibrated instruments required for these tests.

.6 Provide confirmation that instruments have been calibrated in conformance with Hydraulic Institute Standards.

.7 Schedule and attend one pre-testing coordination meeting at least 2 weeks prior to testing to confirm that the testing facility is equipped to measure all testing parameters specified herein.

.8 Factory performance tests shall be undertaken after the pump and its motor, have been running for at least 1 hour and have reached operating temperature. Bearing temperature must be measured and recorded at a minimum of every 15 minutes for the warmup to operating temperature.

.9 RMS vibration measurements shall be measured over the entire test range. The vibration acceptance criteria shall be met at the pump guarantee point under full speed. Vibration levels shall be recorded in accordance with HI standards, included in the shop performance test report and shall be less than the allowable levels required by the HI standards.

.10 Correct any failure to meet the requirements of the Specifications and promptly retest the pump at Supplier's expense.

.11 If, after correction and retesting, the pump still fails to meet the requirements of the Specifications, it may be rejected.

.12 If increased vibration or noise, or a drop-off in performance, or any other sign of cavitation or incipient cavitation occurs over the specified operating range of the pumping unit, the unit shall be rejected.

.13 Provide digital copy of test report which includes certified performance curve showing total dynamic head (TDH) (in metres), capacity (in ML/d), efficiency, speed (in rpm), power (in kilowatts) and minimum submergence to The Engineer for approval. Include all calculations, notes and assumptions in the report. Correct data to speed at full motor load.

.14 Pump performance Acceptance Grade is '1U' per the ANSI/HI Standard at the rated point.

.15 Approval of shop test results by The Engineer is not to be construed as final acceptance of pumping unit.

.16 Final approval will be given subject to the satisfactory installation and operation in place of this equipment, as demonstrated by the Field Testing specified.

.17 The pumps shall not be shipped to the site until Engineer's approval.

.18 Pumping equipment shall be tested as outlined in the specifications and in accordance with the latest version of Hydraulic Institute Standards (American) for centrifugal pumps, and IEEE 112 for electric induction motors, and as required herein.

.2 Shop Test Procedure Submittal Requirements:

.1 Shop testing procedures submittal for testing of the pumping units shall be submitted no later than 4 weeks before the scheduled shop testing date and shall include:

.1 Detailed test procedures including the test layout for the pumps being supplied for this Project.

.2 Details shall include details of equipment to be used, driver, gauges, flow elements, equipment ranges, calibration records, pipe diameters, method of power measurement, instrumentation, data collection methods, etc.

.2 The Submittal Information Required Includes:

.1 Hydrostatic testing of the pumping units:

.1 Each pump shall be subject to a hydrostatic test in accordance with the ANSI/HI 14.6, except that test pressures shall be at least 1.5 times the sum of the shut-off head and the maximum suction head.

.2 A certified test record in accordance with ANSI/HI 14.6 for each pump shall be submitted to The Engineer for review prior to the shop performance test; or

.2 A test bench layout diagram showing pipe sizes, pipe lengths, pressure gauge locations, flow measurement locations and the suction conditions.

.3 Details of equipment, measurement ranges and latest calibration records for the equipment and instruments to be used during the shop performance test including: gauges (pressure or manometer style), flow measurement, and speed measurement (digital tachometer).

.4 A summary of the latest calibration dates for the instruments to be used during the shop performance test and a statement that these instruments are calibrated and maintained in accordance with HI standards is required to be submitted prior to the shop performance testing.

.5 Details of the pump driver to be used for these tests, including method of power measurement. Confirmation of whether actual job motor is being used for testing pumps, and if so provide method of power measurement.

.6 Pump performance data must be evaluated for compliance with the acceptance criteria based on the actual pump speed on the job motor at the full speed of the pump and motor at the rated load resulting from the guarantee point / duty condition.

.7 Method and equipment used for vibration measurements during pump test.

.8 Sample of data collection sheet.

.3 Separate motor shop performance results and curves for the job motors are required to be submitted prior to the pump shop performance testing.

.4 The City and The Engineer require 1 month's notice of the date the remote witnessed shop testing will take place.

.5 Shop Performance Tests on Motors:

.1 Standards: In accordance with IEEE Standard for induction motors. Test all motors at the Supplier's shop or other approved test facility to confirm with the specifications.

.2 Motors shall be tested with all accessories such as shaft grounding rings, and grease lubricated bearings shall be completely lubricated to complete the first service interval without re-greasing.

.3 Each motor shall be tested for efficiency, power factor, rated load slip, noise, vibration and insulation resistance. A complete test as described in IEEE 112, and as specified below, shall be performed on each motor.

.1 Noise measurements must be taken for the motor under full load.

.4 Uncorrected power factor and slip shall be determined for the motor's operating range. Capacitance for the corrected 0.95 power factor shall be calculated for each of the load points. The maximum corrected power factor and the corresponding capacitance shall also be determined.

.5 The temperature rise test shall be at the rated service factor, (i.e., at 1.15 S.F.) of the motor, for the duration applicable to a continuously rated machine. Temperature measurement shall be by the resistance method. If the temperature rise exceeds the specified allowable rise, the motor may be rejected.

.6 Furnish all power, labour, materials and properly calibrated instruments required for these tests.

.7 Any failure to meet the requirements of the Technical Specifications shall be corrected promptly after which the motor shall be retested. If, after correction and retesting, the motor still fails to meet the requirements of the Technical Specifications, it may be rejected.

.8 Submit a motor shop performance test report for review which includes the test data presented on IEEE 112 Standard Forms, and certified performance curves showing:

.1 Efficiency

.2 Un-corrected and corrected power factor

.3 Slip and power output in kilowatts

.4 Power vs. rpm

.5 Amps

.6 Efficiency and power factor

.7 Noise measurements

.8 Temperature rise

.9 Include all calculations, drawing of test arrangement complete with notes and assumptions in the report.

.10 The report shall include the calculations to determine the capacitance for corrected 0.95 power factor and also the maximum corrected power factor.

.9 The approval of The Engineer for the results of the shop tests is not to be construed as being final approval of the pumping unit. Final approval will be given subject to the satisfactory installation and operation in place of this equipment, as demonstrated by the official field performance tests specified hereinafter.

3.4 SHIPMENT

.1 Do not ship either the pumps or the motors to the site until the approval of The Engineer is given.

.2 Satisfactorily complete shop tests for the unit and submit test reports and certified calculations demonstrating compliance with the performance requirements prior to shipment.

.3 Enclose the mating pieces of the equipment assembly drawing in suitable heavy duty wrapping, tied to the equipment assembly, and shipped with the equipment.

.4 Forward a copy of each marked assembly drawing to The Engineer upon shipment of the equipment.

.5 Blank flanged connections with bolted wood or metal covers no smaller than the flange outside diameter.

.6 Fit threaded connections with pipe plugs.

.7 Enclose all exterior bearing housing in polyethylene wrapping to positively exclude moisture, dust or dirt.

.8 Protect electric motor so as to prevent deterioration or damage due to mechanical damage and entry of moisture, dust or dirt into the windings or bearings during shipment.

.9 Ship equipment in manageable sections ready for assembly in place, labelled with shipping weights.

.10 The equipment is to be stored in accordance with the manufacturer’s recommendations. The General Contractor is responsible for providing suitable storage space based on the manufacturer’s recommendations and weather resistance of the equipment packaging.

.11 Provide explicit instruction on the storage of the equipment to prevent deterioration.

.12 Provide explicit lubrication instructions for pump and motor bearings. If motors and/or pump grease lubricated bearings require additional lubrication for storage and/or

operation, this shall be completed by the manufacturer's representative at the storage location.

.13 Coordinate with General Contractor scheduling of equipment shipment, delivery, off-loading and storage.

.14 At all times, protect equipment from damage, construction activities, dust, damp, adverse weather and temperatures.

.15 The packages containing the above shall be tagged individually with the name of the pumping station, the shipping weight, and the purchase order number.

3.5 INSTALLATION

.1 Installation will be performed by the General Contractor. The installation instructions to the General Contractor to include the following requirements:

.2 Install all pumping equipment in strict accordance with manufacturer's instructions.

.3 Make equipment installation and connections by skilled millwrights to the best standard.

.4 Carry out work to produce a neat, accurate, secure, functional installation.

.5 Install anchor bolts and concrete bases in advance of equipment installation, in accordance with manufacturer's instructions.

.6 Prior to grouting, General Contractor to arrange for the equipment manufacturer's technical representative to confirm the alignments are correct and also carry out the pre-startup inspection. Grout in strict accordance with manufacturer's instructions, using materials and methods specified. Torque anchor bolts to manufacturer's specification.

.7 Upon completion of installation, fill, add to, and check equipment requiring lubricating oils, greases and coolants. Types and amounts are to be in strict accordance with manufacturer's recommendations.

.8 The Supplier's technical representative shall inspect the installation to ensure that the equipment has been installed in accordance with the manufacturer's requirements. If the installation is not in order, correct the deficiencies indicated by the technical representative. Start, run, and adjust equipment at this time. The technical representative shall then advise the Engineer in writing that the installation has been checked, has been installed correctly, and is in working order.

.9 Record and submit to The Engineer the final alignment offsets as measured in the field. A representative of The City's maintenance personnel may witness the field alignment checks. Provide 1 week advance notice to The Engineer to allow for scheduling.

3.6 SUPERVISION AND START-UP

.1 Provide a manufacturer's technical representative for installation inspection, start-up and commissioning services. The equipment manufacturer's technical representative shall be familiar with the equipment supplied and shall come prepared with both knowledge and equipment to perform and interpret the manufacturer's requirements for the starting of equipment that has not previously been run. The manufacturer's technical representative shall be present for the following tasks:

Task	Number of Days Per Pump	Number of Visits/Trips Per Pump (to Kenora)
Installation Instructions and Assistance	1	1
Equipment Installation Inspections	2	1
Official Field Performance Tests	3	1

.2 The Supplier shall assist the Engineer in ensuring that the General Contractor carries out the installation of this equipment in a proper and satisfactory manner.

.3 The following are the minimum requirements to be provided by the Supplier and completed to the satisfaction of the Engineer in accordance with the requirements of Division 01:

.1 Installation Instructions and Assistance: Attend a preliminary site meeting to instruct the General Contractor on the unloading, handling, storage, and installation procedures.

.2 Provide an installation checklist for the supplied equipment.

.3 Equipment Installation Inspections: Provide complete inspection prior to start-up, including pump, motor, couplings, and accessories, and check the final field alignment (using laser alignment equipment).

.4 If the inspection reveals defects in work, the technical representative shall notify the Engineer and advise the General Contractor to correct the installation deficiencies.

.5 Official Field Performance Tests: The equipment manufacturer's technical representative shall be present and conduct the Official Field Performance Tests of the equipment (pumps and motors) and interpret the test results and procedures recommended by the manufacturer.

3.7 EQUIPMENT FIELD TESTING PROCEDURE

.1 The General Contractor is to be responsible for all field testing of the pumps and motors including the provision of all instrumentation and labour required. The Supplier's representative is to supervise and witness the field tests.

.2 The Supplier's representative is to submit a thorough description of the procedures to be employed in testing this equipment. The procedure will be reviewed by the Engineer for suitability and should be submitted 4 weeks prior to any testing.

.1 Include:

.1 Intended methods of testing manual and automatic start, stop features.

.2 Safety precautions to be employed.

.3 Previous testing experience of Supplier's personnel or subtrades.

.3 The General Contractor will co-ordinate the schedule for testing with The City, The Engineer and Supplier.

.4 Testing must be carried out with the approval and coordination of The City's operating staff and The Engineer. A minimum of 1 week advance notice will be required.

3.8 FIELD PERFORMANCE TESTS

.1 General:

.1 The purpose of the test is to confirm that the pumping equipment operates:

.1 Within the manufacturer's guidelines.

.2 Within all referenced pump and motor specifications and standards.

.2 Provide all specialized tools and instruments, supervise, and document the field performance tests.

.3 Provide all field set-up documentation, including service technical report.

.2 Field Tests to the Following:

.1 Conduct under actual operating conditions.

.2 Perform after the pump and its motor have been running for at least an hour and have reached operating temperature.

.3 Confirm the pump is operating satisfactorily and within all specified parameters and that the pumping unit is not:

.1 Cavitating.

.2 Overloading.

.3 Overheating.

.4 Vibrating beyond acceptable limits as defined by the HI standards.

.4 Measurements to Include:

.1 Suction and discharge head measured using a calibrated pressure gauge connected to the piping. Use temporarily installed calibrated pressure gauges connected to the piping where permanent gauges are not provided.

.2 Speed measured using a tachometer.

.3 Electrical power input measured using a power quality meter measuring current, voltage, power factor, kVA, KVAR and real power in kW across all 3-phases.

.4 Flow measured using a calibrated flow meter.

.5 Vibration measurements at motor bearings in x-, y- and z-directions in accordance with Hydraulic Institute Standards over the full range of operating speed. Measurements to be taken by a qualified testing firm approved by The Engineer. Prepare a report and submit to The Engineer.

.6 A field performance curve (minimum of 8 points) shall be plotted showing discharge capacity (in ML/d), TDH (in m), pump efficiency (%) and pump power (in kW).

.7 Overall efficiency of the pumping units shall be calculated at rated pump speed, rated capacity, and rated TDH. Field installed pump performance shall be compared to the factory measured performance for each pump at the guarantee points used in the factory performance test.

.5 Review, testing, and commissioning of all control circuitry, all safety and malfunction devices, and general operation checks.

.6 Performance test to be completed to:

.1 The satisfaction of The Engineer.

.2 The satisfaction of the Supplier to ensure that warranty requirements are achieved.

.3 Pump field test performance acceptance grade is '2B' per the ANSI/HI Standard at the guarantee point.

.3 Any faults in the unit are to be corrected promptly after which the unit is to be re-tested. If after corrections and re-testing, the pump still fails to meet the requirements of the Technical Specifications, it may be rejected.

.4 Prepare a report including all testing data in tabular format and presented graphically in the same units as the shop test results and submit to The Engineer within 14 days of testing.

3.9 FINAL INSPECTION

.1 Final inspection will be made by The Engineer only after the General Contractor and Supplier have advised in writing that equipment installation is in order and the system can be operated.

.2 The Engineer will request that the equipment be operated to demonstrate that it will perform as specified.

.3 The Engineer will advise the General Contractor and Supplier in writing of any deficiencies.

.4 Correct the deficiencies and advise The Engineer of their correction. Should the deficiencies be of a sufficiently serious nature the work shall be re-inspected.

.5 In the case of the rejection of the unit, allow the unit to remain in service under the control of The City for such time as may be required for the procurement and installation of a new unit.

3.10 TRAINING

.1 Training for engine, pump and motor to be provided by a manufacturer's technical representative.

.2 Training shall include a presentation and hand-out materials (digital and hard copy) for a minimum of 6 attendees at each training session, and include at a minimum the following topics:

.1 Features of specified pump, and motor.

.2 Spare parts provided.

.3 Normal operating range and impact of operation outside of normal operating range.

.4 Protection equipment and settings.

.5 Daily, weekly, monthly and periodic inspection requirements.

.6 Required maintenance and maintenance frequencies.

.7 Troubleshooting.

.3 Supplier shall provide a training syllabus for review by The City and The Engineer including proposed schedule for training, duration and topics covered.

.4 Training shall be recorded either separately, or during the training session in video format and provided to The City for future reference.

.5 Refer to Section 01 79 00 for additional training requirements.

END OF SECTION

Appendix A

PROCESS CONTROL NARRATIVE FOR HIGH LIFT PUMPS

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

PROCESS CONTROL NARRATIVE

City of Kenora

WTP High and Low Lift Pumps Replacement

JUNE 2025

TABLE OF CONTENTS

1 GENERAL OVERVIEW

1.1 Terms Used in Document

Automatic: Control system directed normal mode of operation.
Semi-Auto: Operator controlled through an HMI.
Hand: Switch controlled from local panel.
PLC: Programmable Logic Computer.
HMI: Human-Machine Interface.
TBD: To be determined.

1.2 Related Sections

- Section 25 10 00 – Integrated Automation and Network Equipment.
- Section 25 90 00 - Programming Implementation Standards.

1.3 Definitions

Refer to Section 25 90 00 - Programming Implementation Standards, Item 1.6 for definitions.

1.4 Controlling

The following are examples of equipment and process variables to be controlled and displayed:

- Motor starter and valve actuator: Auto and Semi-automatic mode selectable switch on human-machine interface (HMI).
- If auto mode is selected, all equipment will be controlled by programming logic.
- If semi-auto is selected all control will be done on equipment faceplates.
- Semi-auto mode puts the responsibility of starting and stopping the equipment on the operator, however, equipment permissive for protection (for example, running a pump when the reservoir is empty), are still active.

1.5 Monitoring

All system components that have information available via the programmable logic controller (PLC) input/output (I/O) will be monitored by the PLC/HMI Automation System. Feedback is provided via the HMI screen to which the equipment is most closely related.

The following are examples of equipment and process variables to be monitored and displayed:

- Motor status: run, stop, fault (run = green, stop = red, fault = yellow).
- Open/close valve status: opening, closing, fully open, fully closed (opening = flashing green, closing = flashing red, full open = green, full closed = red).
- Modulating valves status: open, closed (full open = green, full closed = red) In transition = green with percent open.
- Motor speed: if equipped with a VFD (0 to 100%).
- Motor run time: decimal hours.

- Water level: meters to top of pump intake with two decimals.
- Flow rate: L/s.
- Electrical utility status: failed or normal; manual transfer switch status: power from portable generator.
- Total water flow: m3.
- Pressure: kPa.

1.6 Alarm

Refer to Section 25 90 00 - Programming Implementation Standards, Item 3.3.

2 LOW LIFT PUMPING

2.1 Process Description

2.1.1 Low Lift Pumping and Filtration

Raw water from the lake enters the plant raw water well by gravity then uses the three low lift pumps (LLP 1, LLP 2, and LLP 3) to transfer water to the clarifier basins operating in a lead/lag/standby configuration. Low lift combined discharge header flow is monitored by the clarifier influent flow meter (FIT-100).

Filtration between the Clarifier and Clearwell is distributed between four filters (FLT1, FLT2, FLT3, FLT4). Flow is divided equally between all filters in operation, filters are taken out of operation during filter backwash cycle and when operator manually sets as out of service from the SCADA. Filter effluent flow is monitored by its respective flow meter (FIT-101, 102, 103 and 104).

Filtration is called to start at the clearwell (LIT-300) operator adjustable start filtration level. Filter influent valves (IV01, IV02, IV03, and IV04) and effluent valves (EV01, EV02, EV03, and EV04) respectively on each in service filter open. The operator adjustable filter effluent flow setpoint starts at a base value and increases linearly as the clearwell level continues to drop until the maximum flow rate setpoint is achieved.

Existing Operations:

Lead/lag pumps are pump 1 or pump 2 and are selected by the operator from the SCADA, pump 3 is maintained as standby.

- The lead Low Lift pump is called to start and ramps up to match the filter effluent flow setpoint biased by the channel level (LIT-100) rising or dropping beyond operator adjustable setpoints.
- If the channel level rises over the high setpoint, the Low Lift flow is decreased by the percentage value of the high channel level setpoint.
- If the channel levels drops below the low setpoint, the Low Lift flow is increased by the percentage value of the low channel level setpoint.
- If the Low Lift flow falls below the required flow for set time while the lead pump is running above 98% speed the standby pump starts. The pumps operate in unison to match the flow requirement.
- If the flow requirement decreases and the pumps are running below 50% speed the standby pump shuts down and the lead pump ramps up to maintain the flow requirement.

Proposed Operations:

If automatic alteration is enabled the pumps alternate after each lead pump start (or time of day), if the lead pump is out of service, or the operator manually alternates pumps from the SCADA. When alternating, the lead pump becomes the standby pump, lag pump becomes lead pump, and standby pump becomes lag pump. If the lag pump is out of service, the standby pump becomes the lag pump.

The lead Low Lift pump is called to start and ramps up to match the filter effluent flow setpoint biased by the channel level (LIT-100) rising or dropping beyond operator adjustable setpoints.

- If the channel level rises over the high setpoint, the Low Lift flow is decreased by the percentage value of the high channel level setpoint.

- If the channel levels drops below the low setpoint, the Low Lift flow is increased by the percentage value of the low channel level setpoint.
- If the Low Lift flow falls below the required flow for set time while the lead pump is running above 98% speed the lag pump starts and the pumps operate in unison to match the flow requirement.
- If the flow requirement decreases and the pumps are running below 50% speed the lag pump shuts down and the lead pump ramps up to maintain the flow requirement.

When the clearwell level rises above the operator adjustable stop filtration setpoint the Low Lift pumps stop and the filter influent and effluent valves close.

2.2 Major Equipment

- Low Lift Pump 1 LLP1
- Low Lift Pump 2 LLP2
- Low Lift Pump 3 LLP3
- Clarifier Influent Flow Transmitter FIT-100
- Channel Level Transmitter LIT-100
- Filter Effluent Header Flow Transmitter FIT-100
- Clearwell Level Transmitter LIT-300

2.3 Interlocks

- If a Fail to Start, Fail to Stop, Fault, Failed to Achieve Speed, Speed Feedback Out of Range, High Temperature, or High Vibration alarm is active, lock out the associated pump.

2.4 Alarms

- Low Lift Pump 1 LLP1 Not in Auto
- Low Lift Pump 1 LLP1 Fail to Start
- Low Lift Pump 1 LLP1 Fail to Stop
- Low Lift Pump 1 LLP1 Fail to Achieve Speed
- Low Lift Pump 1 LLP1 Speed Feedback Signal Out of Range
- Low Lift Pump 1 LLP1 Fault
- Low Lift Pump 1 LLP1 Emergency Shutdown
- Low Lift Pump 2 LLP2 Not in Auto
- Low Lift Pump 2 LLP2 Fail to Start
- Low Lift Pump 2 LLP2 Fail to Stop
- Low Lift Pump 2 LLP2 Fail to Achieve Speed
- Low Lift Pump 2 LLP2 Speed Feedback Signal Out of Range
- Low Lift Pump 2 LLP2 Fault
- Low Lift Pump 2 LLP2 Emergency Shutdown
- Low Lift Pump 3 LLP3 Not in Auto
- Low Lift Pump 3 LLP3 Fail to Start
- Low Lift Pump 3 LLP3 Fail to Stop
- Low Lift Pump 3 LLP3 Fail to Achieve Speed
- Low Lift Pump 3 LLP3 Speed Feedback Signal Out of Range
- Low Lift Pump 3 LLP3 Fault

- Low Lift Pump 3 LLP3 Emergency Shutdown
- Clarifier Influent Flow FIT-100 Signal Out of Range
- Clarifier Influent Flow FIT-100 No Flow
- Channel Level LIT-100 High-High
- Channel Level LIT-100 Low-Low
- Channel Level LIT-100 Signal Out of Range
- Filter Effluent Header Flow FIT-100 High
- Filter Effluent Header Flow FIT-100 Low
- Filter Effluent Header Flow FIT-100 Signal Out of Range
- Clearwell Level LIT-300 High
- Clearwell Level LIT-300 Low
- Clearwell Level LIT-300 Low-Low
- Clearwell Level LIT-300 Signal Out of Range

2.5 Operating Set Points

Operating Set Points	Range	Value	Units
Channel High Level Bias	TBD	TBD	%
Channel Low Level Bias	TBD	TBD	%
Channel High Level	TBD	TBD	m
Channel Low Level	TBD	TBD	m
Clearwell Full Level (CFL)	TBD	3	m
Clearwell Level Filtration Start	TBD	CFL – 0.04	m
Clearwell Level Filtration Maximum Rate	TBD	CFL – 0.3	m
Filtration Minimum Rate	TBD	8000	m^3/d
Filtration Maximum Rate	TBD	15000	m^3/d

2.6 Alarm Set Points

Alarm Set Points	Range	Standard Setting	Units
Channel Level High-High	TBD	TBD	m
Channel Level Low-Low	TBD	TBD	m
Clearwell Level High	TBD	TBD	m
Clearwell Level Low	TBD	TBD	m
Clearwell Level Low-Low	TBD	TBD	m

3 HIGH LIFT PUMPING

3.1 Process Description

3.1.1 Pumping

High Lift flow is supplied by three pumps (HLP1R, HLP2R, and HLP3R) operating in a lead/lag/standby configuration. Each pump discharge has an electric check valve (1HLC, 2HLC, 3HLC respectively) operated by two solenoids, a 'Not-Closed' and an 'Open' solenoid. The Not-Closed solenoid prevents the valve from opening when de-energized. The check valve only opens if both the Open and Not-Closed solenoids are energized.

Existing Operation:

Pumps 1 and 3 operate as lead/standby while pump 2 typically operates as the lag pump.
Pump and valve controls are managed by manual selection switches and relay logic in the MCC.

Proposed Operation:

If automatic alteration is enabled the lead pump alternates at operator adjustable time of day, if the lead pump is out of service, or the operator manually alternates pumps from the SCADA. Under normal conditions only one High Lift pump operates at a time. Pumps cycle from lead to lag to standby when automatically alternating.

The operator can select for the pumps to operate in 'Normal Mode' or 'Distribution Mode' from the SCADA system. In Normal Mode the pumps maintain an operator adjustable flow rate (FIT-200) biased by both estimated flow out of the Zone 1 Standpipe based on the level moving average and relative level of the standpipe to maintain setpoint. Calculation as follows:

PD = (1 + ((SLM – SAL)/(Stop - Start))) x SAD

PD = Pump Discharge Rate (FIT-200)
SLM = Standpipe Level to Maintain
SAL = Standpipe Actual Level
Start = Start Pumping Setpoint
Stop = Stop Pumping Setpoint
SAD = Standpipe Average Discharge (Calculated moving average based on change in level)

Standpipe levels are to fluctuate during winter to prevent freezing when required, operators must review daily level trending and adjust settings as required to prevent freezing. Level control is not recommended in winter.

In Distribution Mode the pumps maintain an adjustable pressure setpoint (PIT-XXX).

The Zone 1 Standpipe operator adjustable start pumping setpoint initiates the start of the lead High Lift pump. When a pump is called to start the associated electric check valve operates in the following manner:

1. Associated pump is called to run.
2. Pump run status is confirmed.
3. Open solenoid is energized.
4. Not-Close solenoid is energized.

When a pump is called to stop the check valve operations as follows:

1. Open solenoid is de-energized.
2. Wait 30 seconds for check valve to close.
3. Not-Open status is confirmed.
4. Not-Close solenoid is de-energized.
5. Pump is called to stop.

Check valve remains closed until the discharge pressure (PT-XXX/X/X respectively) reaches a hard-coded pressure set point. If the pressure does not reach set point within a limited time a pump failed to start alarm is activated and the check valve remains closed.

Each check valve has four (4) limit switches that trigger as follows:

1. XX% open, pumping enabled, valve opening – Trim chlorination valve is called to open
2. XX% open, pumping enabled, valve opening – Return valve open status signal to PLC
3. XX% open, pumping disabled, valve closing – Trim chlorination valve is called to close
4. 5% open, pumping disabled, valve closing – Pump ramped down to full stop

When a pump is disabled or called to stop the check valve is closed; the trim chlorine valve closes and pump ramps down to a stop at the valve limits described above. In the event of a power failure the emergency electric check valve solenoids (SV-XXX-X/X/X) and the electric check valve solenoid both fail closed and the check valve closes to prevent backflow.

If the discharge header flow is reversed (FIT-200) open check valves are closed as described for power loss and the running pumps are disabled.

When the check valve status open is confirmed the lead pump ramps up to achieve the flow (Normal Mode) or pressure (Distribution Mode) set points. If the value falls below the associated operator adjustable setpoint for set time while the lead pump is running above 98% speed the lag pump is called to start. The pumps operate in unison to maintain the setpoint. If the system demand decreases and flow or pressure (depending on mode) rise above the stop lag setpoint the lag pump is disabled and the lead pump ramps up to maintain the operating setpoint. If the Standpoint level rises above the lead pump stop setpoint, the lead pump is ramped down and stopped.

When the lag pump is started nuisance chlorine alarms may be triggered, to ensure this does not impact operations the pipe stand low-level level and low-pressure setpoints are always above the lag start setpoint to alert operators prior to pump start.

3.2 Major Equipment

- High Lift Pump 1 HLP1R
- High Lift Pump 2 HLP2R
- High Lift Pump 3 HLP3R
- High Lift Pump 1 Suction Pressure Transmitter PT-XXX
- High Lift Pump 2 Suction Pressure Transmitter PT-XXX
- High Lift Pump 2 Suction Pressure Transmitter PT-XXX

- High Lift Pump 1 Discharge Pressure Transmitter PT-XXX
- High Lift Pump 2 Discharge Pressure Transmitter PT-XXX
- High Lift Pump 3 Discharge Pressure Transmitter PT-XXX
- HLP1R Not-Open Check Valve Solenoid 1HLC
- HLP2R Not-Open Check Valve Solenoid 2HLC
- HLP3R Not-Open Check Valve Solenoid 3HLC
- HLP1R Open Check Valve Solenoid 1HLC
- HLP2R Open Check Valve Solenoid 2HLC
- HLP3R Open Check Valve Solenoid 3HLC
- Standpoint Level Transmitter LIT-XXX
- Effluent Flow Transmitter FIT-200
- Effluent Pressure Transmitter PIT-XXX
- Effluent Free/Total Chlorine Analyzer CL2IT-200
- Effluent Ph Analyzer PHIT-200
- Effluent Turbidity Analyzer JJUIT-200

3.3 Interlocks

- If the clearwell effluent free chlorine low-low alarm (AIT-XXX) is active the High Lift pumps are locked out.
- If a Fail to Start, Fail to Stop, Fault, Failed to Achieve Speed, Speed Feedback Out of Range, High Temperature, or High Vibration alarm is active, lock out the associated pump and close associated check valve.
- If a check valve Fail to Open alarm is active, lock out the associated pump.

3.4 Alarms

- High Lift Pump 1 HLP1R Not in Auto
- High Lift Pump 1 HLP1R Fail to Start
- High Lift Pump 1 HLP1R Fail to Stop
- High Lift Pump 1 HLP1R Fail to Achieve Speed
- High Lift Pump 1 HLP1R Speed Feedback Signal Out of Range
- High Lift Pump 1 HLP1R Fault
- High Lift Pump 1 HLP1R Emergency Shutdown
- High Lift Pump 2 HLP2R Not in Auto
- High Lift Pump 2 HLP2R Fail to Start
- High Lift Pump 2 HLP2R Fail to Stop
- High Lift Pump 2 HLP2R Fail to Achieve Speed
- High Lift Pump 2 HLP2R Speed Feedback Signal Out of Range
- High Lift Pump 2 HLP2R Fault
- High Lift Pump 2 HLP2R Emergency Shutdown
- High Lift Pump 3 HLP3R Not in Auto
- High Lift Pump 3 HLP3R Fail to Start
- High Lift Pump 3 HLP3R Fail to Stop
- High Lift Pump 3 HLP3R Fail to Achieve Speed
- High Lift Pump 3 HLP3R Speed Feedback Signal Out of Range
- High Lift Pump 3 HLP3R Fault
- High Lift Pump 3 HLP3R Emergency Shutdown
- High Lift Pump 1 Suction Pressure PT-XXX Low

- High Lift Pump 1 Suction Pressure PT-XXX Low-Low
- High Lift Pump 1 Suction Pressure PT-XXX Signal Out of Range
- High Lift Pump 2 Suction Pressure PT-XXX Low
- High Lift Pump 2 Suction Pressure PT-XXX Low-Low
- High Lift Pump 2 Suction Pressure PT-XXX Signal Out of Range
- High Lift Pump 2 Suction Pressure PT-XXX Low
- High Lift Pump 2 Suction Pressure PT-XXX Low-Low
- High Lift Pump 2 Suction Pressure PT-XXX Signal Out of Range
- High Lift Pump 1 Discharge Pressure PT-XXX High
- High Lift Pump 1 Discharge Pressure PT-XXX Low
- High Lift Pump 1 Discharge Pressure PT-XXX Low-Low
- High Lift Pump 1 Discharge Pressure PT-XXX Signal Out of Range
- High Lift Pump 2 Discharge Pressure PT-XXX High
- High Lift Pump 2 Discharge Pressure PT-XXX Low
- High Lift Pump 2 Discharge Pressure PT-XXX Low-Low
- High Lift Pump 2 Discharge Pressure PT-XXX Signal Out of Range
- High Lift Pump 3 Discharge Pressure PT-XXX High
- High Lift Pump 3 Discharge Pressure PT-XXX Low
- High Lift Pump 3 Discharge Pressure PT-XXX Low-Low
- High Lift Pump 3 Discharge Pressure PT-XXX Signal Out of Range
- HLP1R Check Valve 1HLC Fail to Open
- HLP1R Check Valve 1HLC Fail to Close
- HLP2R Check Valve 2HLC Fail to Open
- HLP2R Check Valve 2HLC Fail to Close
- HLP3R Check Valve 3HLC Fail to Open
- HLP3R Check Valve 3HLC Fail to Close
- Standpoint Level LIT-XXX High
- Standpoint Level LIT-XXX Low
- Standpoint Level LIT-XXX Signal Out of Range
- Effluent Flow FIT-200 High
- Effluent Flow FIT-200 Low
- Effluent Flow FIT-200 Signal Out of Range
- Effluent Flow FIT-200 Backflow
- Effluent Pressure PIT-XXX High
- Effluent Pressure PIT-XXX Low
- Effluent Pressure PIT-XXX Signal Out of Range
- Effluent Free Chlorine CL2IT-200 High-High
- Effluent Free Chlorine CL2IT-200 High
- Effluent Free Chlorine CL2IT-200 Low
- Effluent Free Chlorine CL2IT-200 Low-Low
- Effluent Free Chlorine CL2IT-200 Signal Out of Range
- Effluent pH PHIT-200 High-High
- Effluent pH PHIT-200 High
- Effluent pH PHIT-200 Low
- Effluent pH PHIT-200 Low-Low
- Effluent pH PHIT-200 Signal Out of Range

- Effluent Turbidity JJUIT-200 High-High
- Effluent Turbidity JJUIT-200 High
- Effluent Turbidity JJUIT-200 Signal Out of Range
- Clearwell Contamination (Backflow from distribution)

3.5 Operating Set Points

Operating Set Points	Range	Value	Units
High Lift Pump Flow Rate	TBD	TBD	m^3/d
Distribution Pressure	530-552	TBD	kPa
Standpipe Level – Start Pumping	TBD	10.5	m
Standpipe Level To Maintain	TBD	11	m
Standpipe Level – Stop Pumping	TBD	11.5	m
Flow Rate Lag Pump Start	TBD	TBD	m^3/d
Flow Rate Lag Pump Stop	TBD	TBD	m^3/d
Distribution Pressure Lag Pump Start	TBD	TBD	kPa
Distribution Pressure Lag Pump Stop	TBD	TBD	kPa
Pump Alteration		11AM/ Wed	Hr/Week Day

3.6 Alarm Set Points

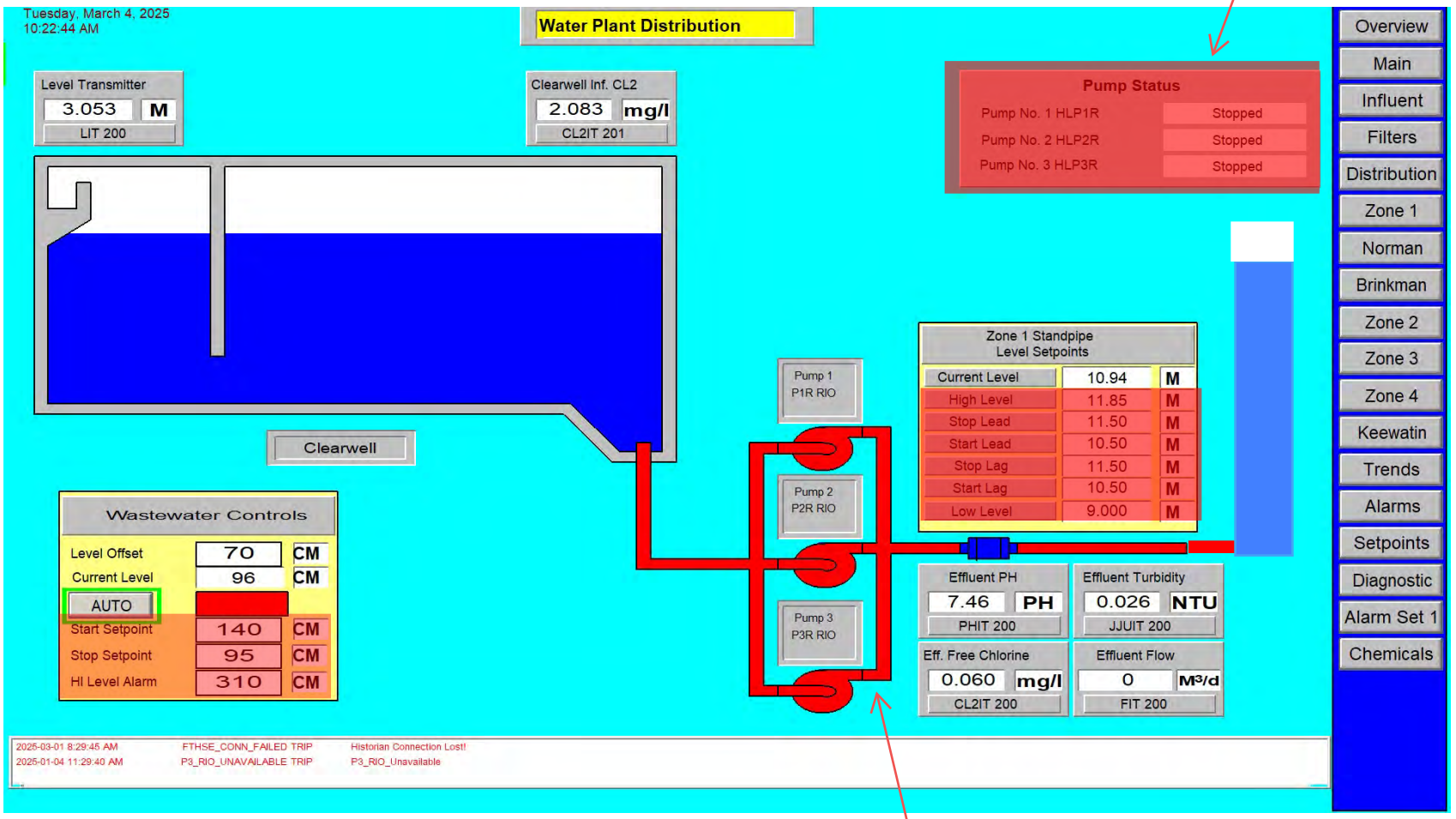
Alarm Set Points	Range	Standard Setting	Units
Standpipe Level High	TBD	11.85	m
Standpipe Level Low	TBD	9	m
Pump Suction Pressure Low	TBD	TBD	kPa
Pump Suction Pressure Low-Low	TBD	TBD	kPa
Pump Discharge Pressure High	TBD	TBD	kPa
Pump Discharge Pressure Low	TBD	TBD	kPa
Pump Discharge Pressure Low-Low	TBD	TBD	kPa
Effluent Flow High	TBD	18000	m^3/d
Effluent Flow Low	TBD	0	m^3/d
Distribution Pressure High	TBD	100	kPa
Distribution Pressure Low	TBD	35	kPa
Effluent Free Chlorine High-High	TBD	TBD	mg/L

Alarm Set Points	Range	Standard Setting	Units
Effluent Free Chlorine High	TBD	0.750	mg/L
Effluent Free Chlorine Low	TBD	0	mg/L
Effluent Free Chlorine Low-Low	TBD	0.60	mg/L
Effluent Total Chlorine High-High	TBD	TBD	mg/L
Effluent Total Chlorine High	TBD	2.8	mg/L
Effluent Total Chlorine Low	TBD	1.5	mg/L
Effluent Total Chlorine Low-Low	TBD	1.2	mg/L
Effluent pH High-High	TBD	TBD	pH
Effluent pH High	TBD	9.2	pH
Effluent pH Low	TBD	6.8	pH
Effluent pH Low-Low	TBD	TBD	pH
Effluent Turbidity High-High	TBD	TBD	NTU
Effluent Turbidity High	TBD	0.3	NTU
High Turbidity Alarm Delay	TBD	120	s

Appendix B

SCADA SCREEN UPDATES

Update to show VFD speeds on all relevant HMI screens, indicate pump lead/lag/standby status, auto status, and 'in alarm' for any active alarm



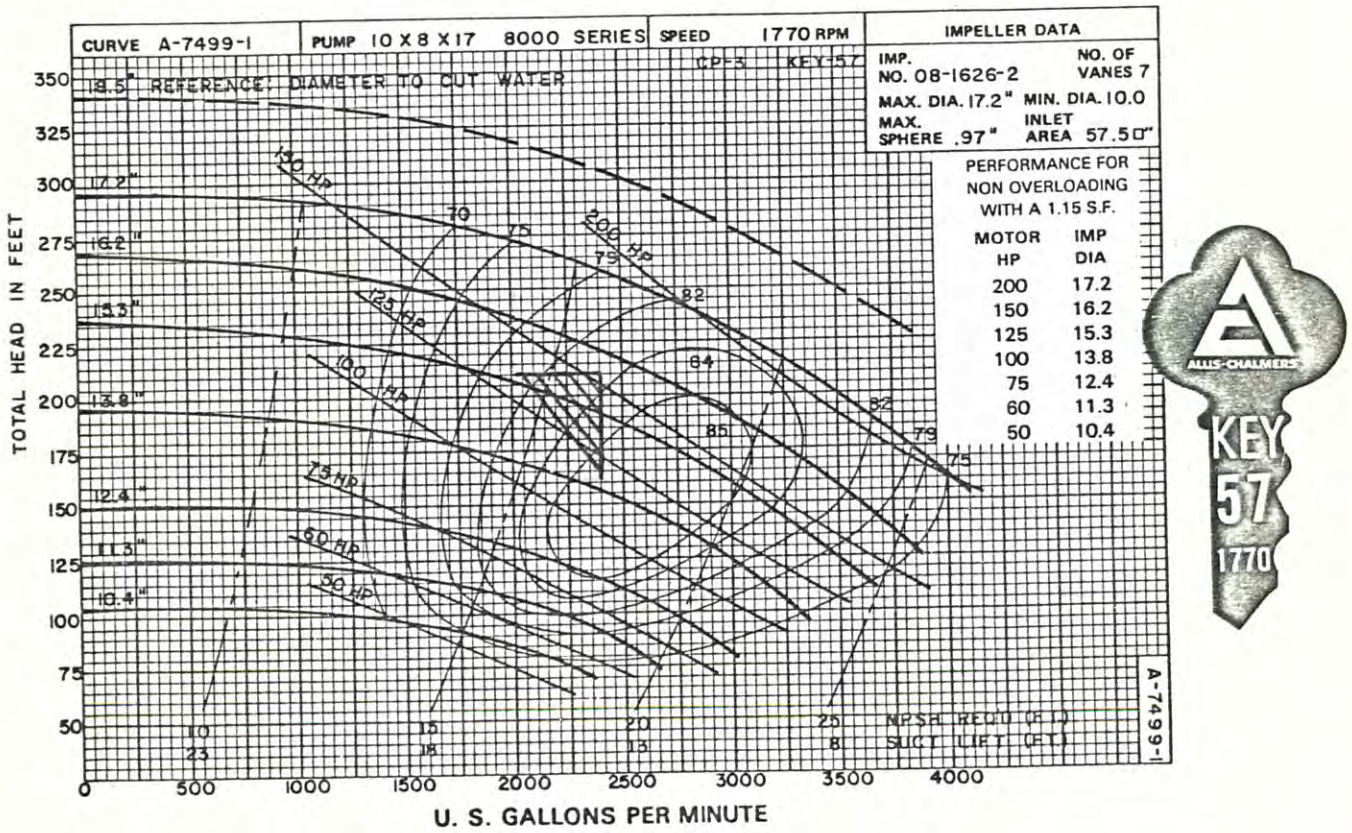
Add new screen for High Lift VFD control (selectable by operator)
Speed Control Mode: Set Hz with on/off operation
Pressure Control Mode: VFD to modulate to hold target pressure
Flow Control Mode: VFD to modulate to target flow rate from plant

Show check valves on each pump discharge with indications for position based on limit switches. Also indicate discharge pressure.

Appendix C

HIGH LIFT PUMP CURVE

235



Curves show performance with clear water at 85°F. If specific gravity is other than 1.0, BHP must be corrected.

ALLIS-CHALMERS

Pump No 1

CURVE NO B-71726

08-305-969- 16.600

P.O. 77-0520-A

10.00 X 8.00 X 17.0 - 8000

G.P.M. 2400. FT. HD. 210.0 R.P.M. 1750

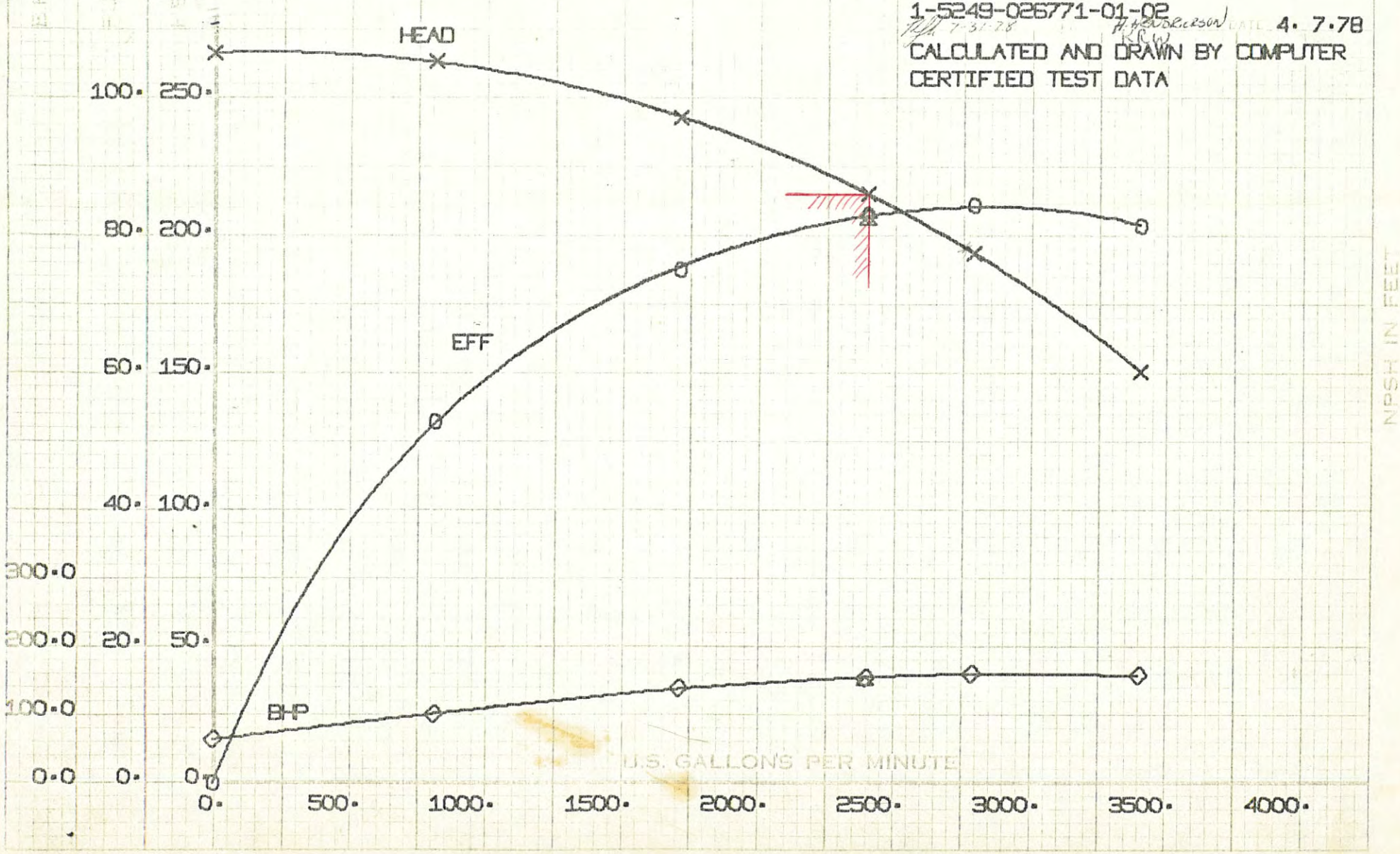
GRAY ENGR

1-5249-026771-01-02

DATE 4. 7.78

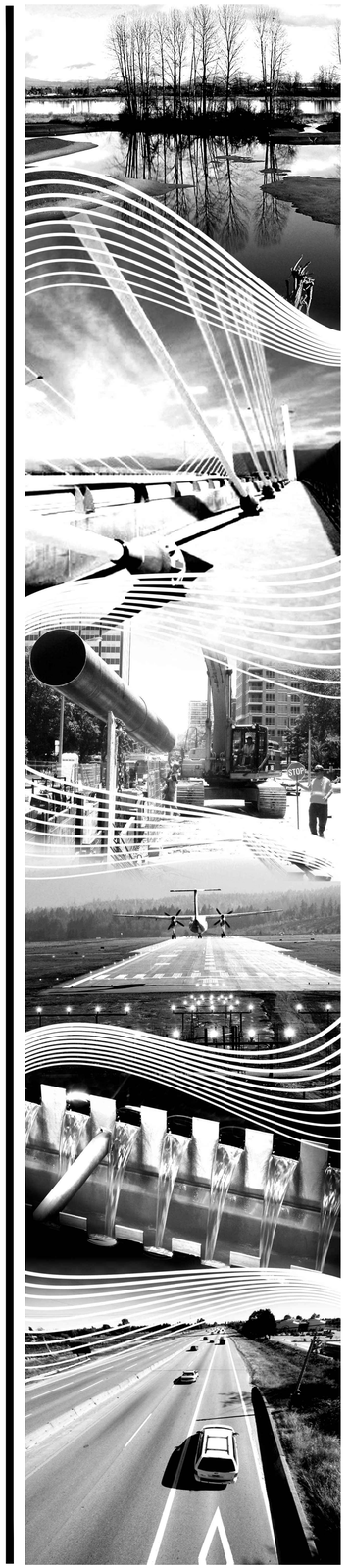
CALCULATED AND DRAWN BY COMPUTER

CERTIFIED TEST DATA



SHEET LIST TABLE

SHEET	DRAWING NAME	REVISION	DRAWING TITLE	DRAWING DESCRIPTION
GENERAL				
1	5895-01-G-001	0	COVER SHEET	
2	5895-01-G-101	0	WORK LOCATION SITE PLAN	
CIVIL				
3	5895-01-C-101	0	EXISTING SITE PLAN	
BUILDING				
4	5895-01-A-101	0	EXISTING SUB-BASEMENT FLOOR PLAN	
5	5895-01-A-102	0	EXISTING BASEMENT FLOOR PLAN	
6	5895-01-A-103	0	EXISTING MAIN FLOOR PLAN	
STRUCTURAL				
7	5895-01-S-101	0	EXISTING SUB-BASEMENT FLOOR PLAN	HOUSEKEEPING PAD
PROCESS				
8	5895-01-DD-101	0	EXISTING SUB-BASEMENT FLOOR PLAN & SECTION	PUMP DEMOLITION - HIGH LIFT STATION
9	5895-01-D-101	0	EXISTING SUB-BASEMENT FLOOR PLAN & SECTIONS	PUMP INSTALLATION - HIGH LIFT STATION
10	5895-01-D-501	0	DETAILS	
ELECTRICAL				
11	5895-01-E-001	0	LEGEND	
12	5895-01-E-011	0	SINGLE LINE DIAGRAM	MCC AND VFD PANEL
13	5895-01-ED-101	0	EXISTING SUB-BASEMENT FLOOR PLAN	DEMOLITION
14	5895-01-E-101	0	EXISTING MAIN AND SUB-BASEMENT FLOOR PLANS	
15	5895-01-E-102	0	EXISTING MAIN FLOOR PLAN AND PHOTOS	ELECTRICAL ROOM MCC
16	5895-01-E-103	0	EXISTING SUB-BASEMENT FLOOR PLAN & PHOTOS	HIGH LIGHT POWER CABLES AND VFD PANEL
17	5895-01-E-501	0	DETAILS	
18	5895-01-E-601	0	SCHEMATIC	HIGH LIFT PUMP VFD
INSTRUMENTATION				
19	5895-01-EI-101	0	EXISTING BASEMENT FLOOR PLAN AND PHOTOS	CONTROL CABLING / DEVICES
20	5895-01-EI-102	0	EXISTING SUB-BASEMENT FLOOR PLAN	CONTROL CABLING / DEVICES
21	5895-01-EI-501	0	DIAGRAMS AND DETAIL	HIGH LIFT REMOTE IO PANEL
22	5895-01-EI-502	0	DIAGRAM	RACK 1, SLOT 1 WIRING
23	5895-01-EI-503	0	DIAGRAM	RACK 1, SLOT 2 WIRING
24	5895-01-EI-601	0	DIAGRAM	NETWORK CONTROL COMMUNICATIONS



Associated Engineering

BEST MANAGED COMPANIES
Platinum member

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

Lake of the Woods KENORA

CITY OF KENORA
WATER TREATMENT PLANT 2025
PUMP REPLACEMENT

Issued for Tender - July 2025

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	K. ANDERSON	C. HENDRICKS	ISSUED FOR TENDER

DRAWING	REVISION	SHEET
5895-01-G-001	0	1

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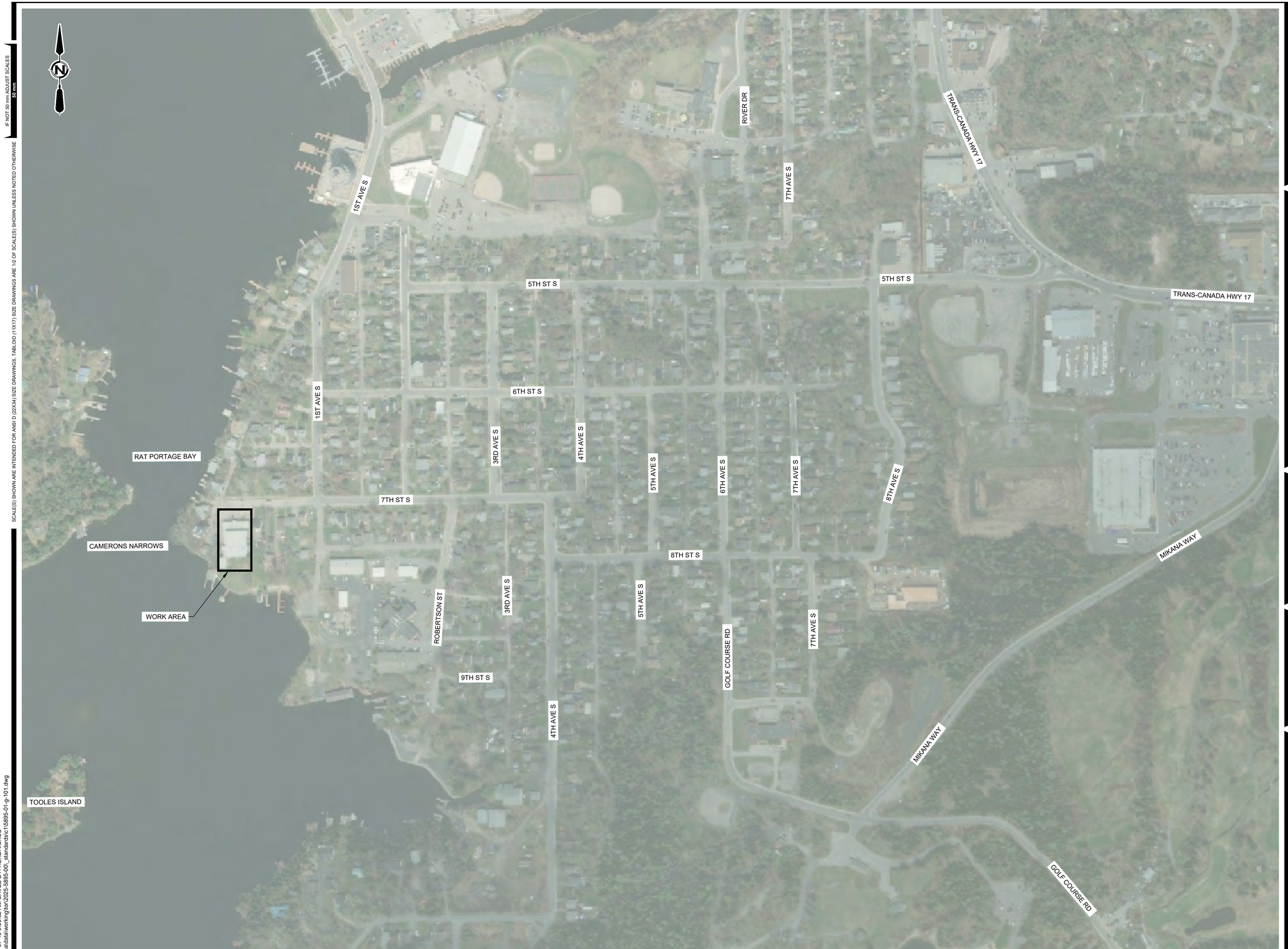
IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 - PLAN 1:2500
WORK LOCATION SITE

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Associated Engineering

BEST MANAGED COMPANIES
Platinum member

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	K. ANDERSON	C. HENDRICKS	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

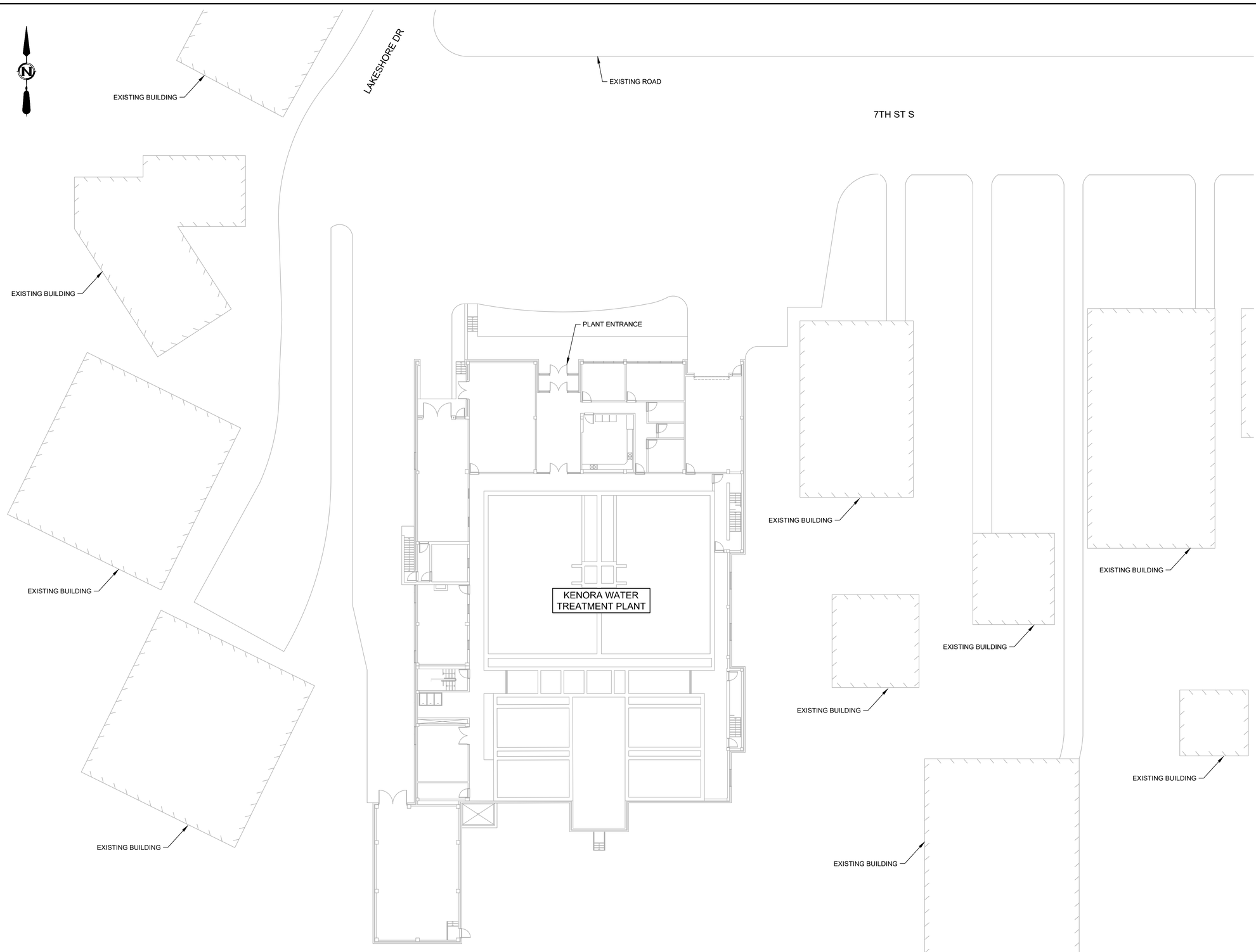
CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

GENERAL
WORK LOCATION SITE PLAN

DRAWING	REVISION	SHEET
5895-01-G-101	0	2



1 - PLAN 1:200
EXISTING SITE

Associated Engineering

CANADA'S BEST MANAGED COMPANIES
Platinum member

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	K. ANDERSON	C. HENDRICKS	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

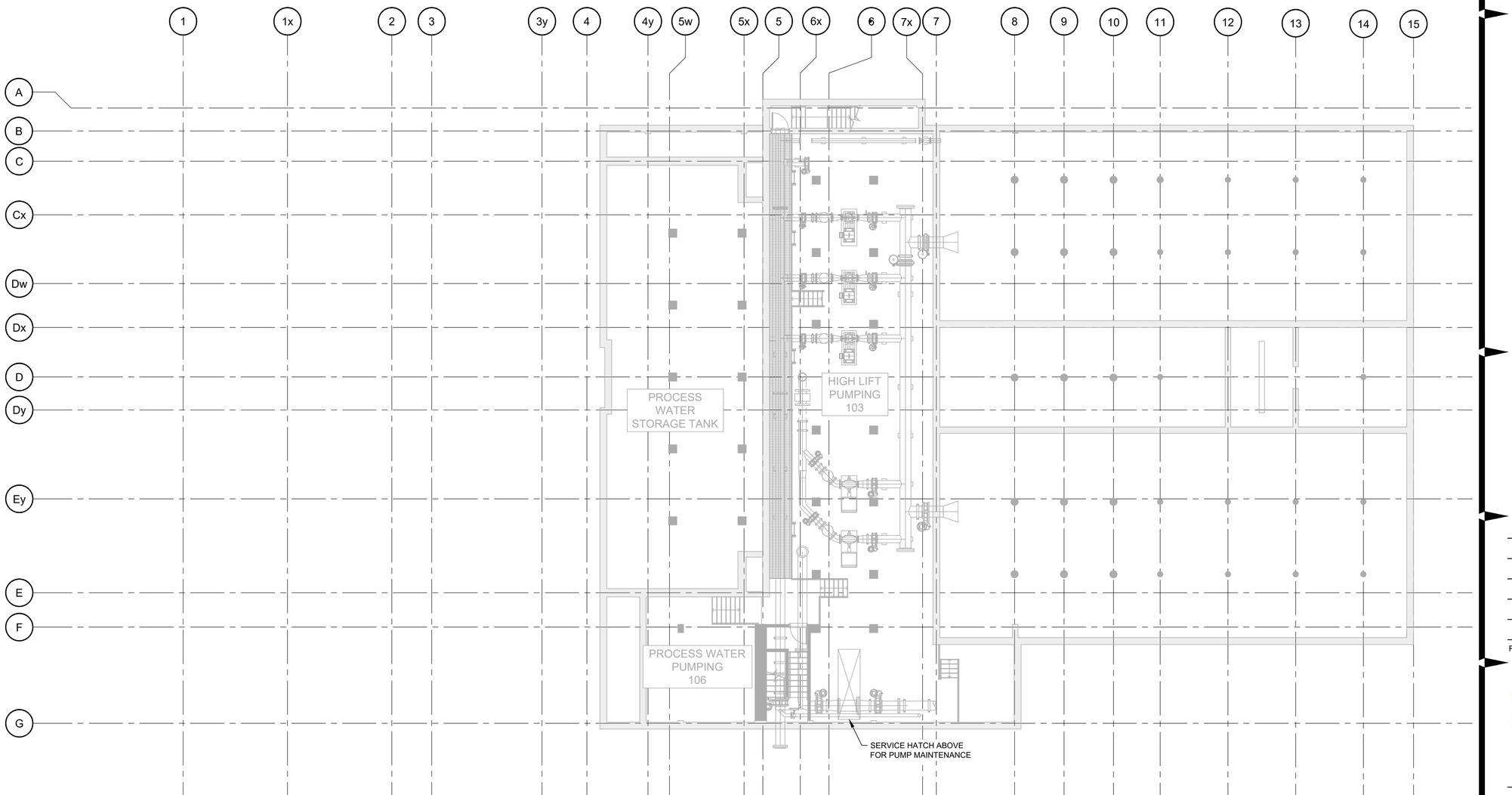
CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

CIVIL
EXISTING SITE PLAN

DRAWING	REVISION	SHEET
5895-01-C-101	0	3



1 - PLAN 1:125

EXISTING SUB-BASEMENT FLOOR

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	K. ANDERSON	C. HENDRICKS	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

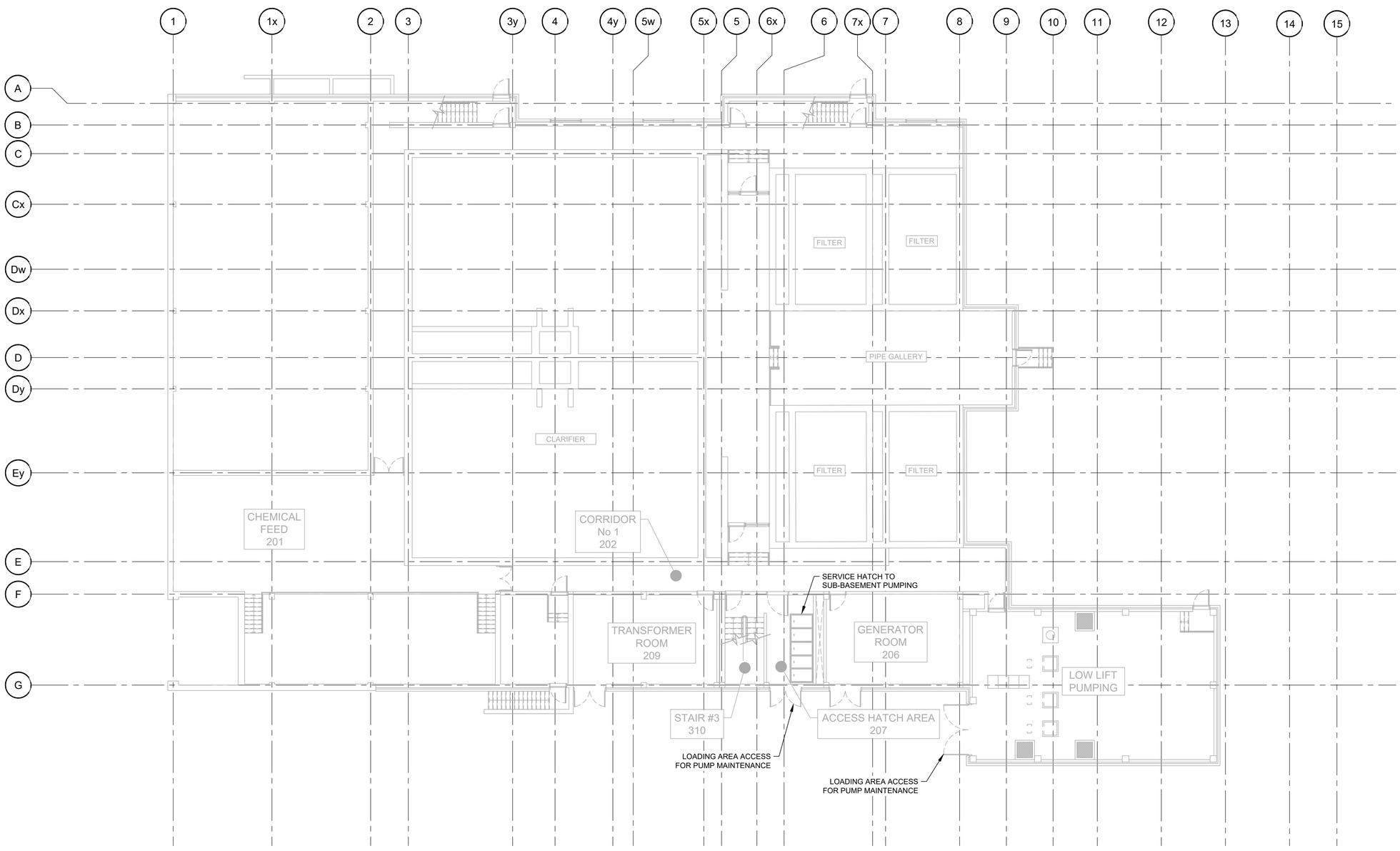
CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

BUILDING
EXISTING SUB-BASEMENT FLOOR PLAN

DRAWING	REVISION	SHEET
5895-01-A-101	0	4



1 / - PLAN 1:125
EXISTING BASEMENT FLOOR

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	K. ANDERSON	C. HENDRICKS	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

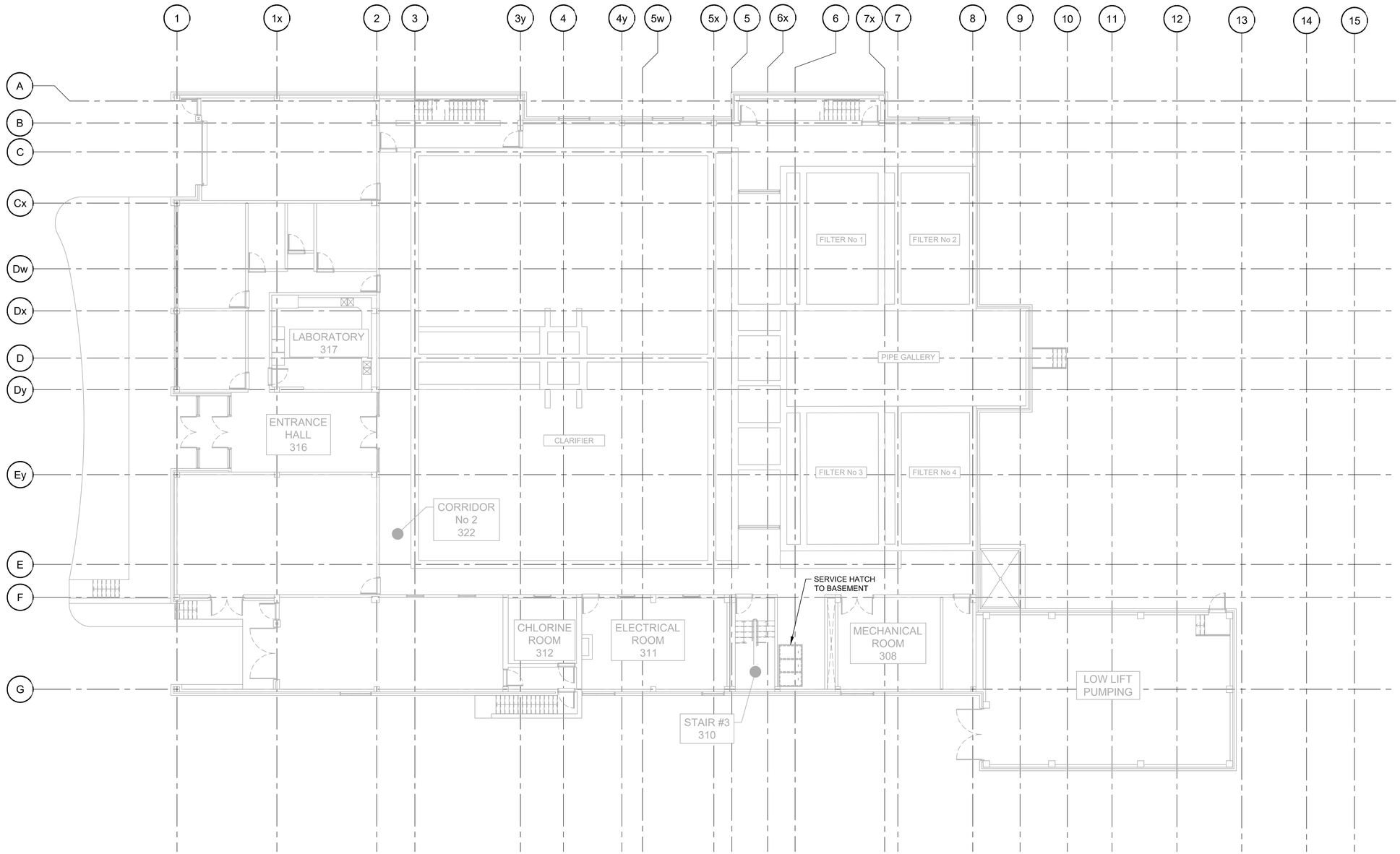
SCALE: AS SHOWN

BUILDING
EXISTING BASEMENT FLOOR PLAN

DRAWING	REVISION	SHEET
5895-01-A-102	0	5

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 / - PLAN 1:125

EXISTING MAIN FLOOR

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	K. ANDERSON	C. HENDRICKS	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

BUILDING
EXISTING MAIN FLOOR PLAN

DRAWING	REVISION	SHEET
5895-01-A-103	0	6

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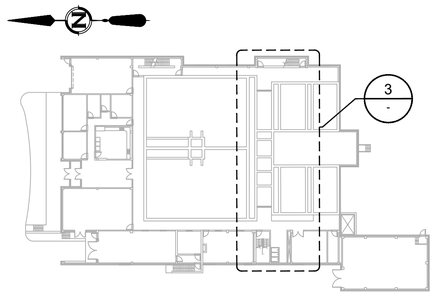

1 - PLAN 1:500

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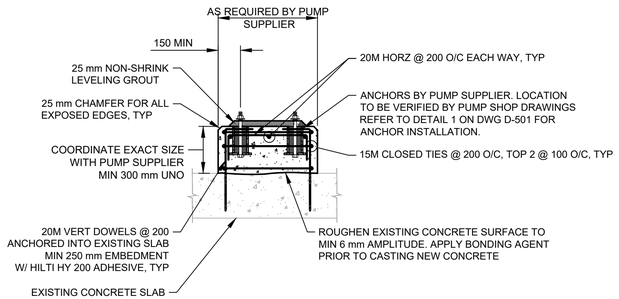
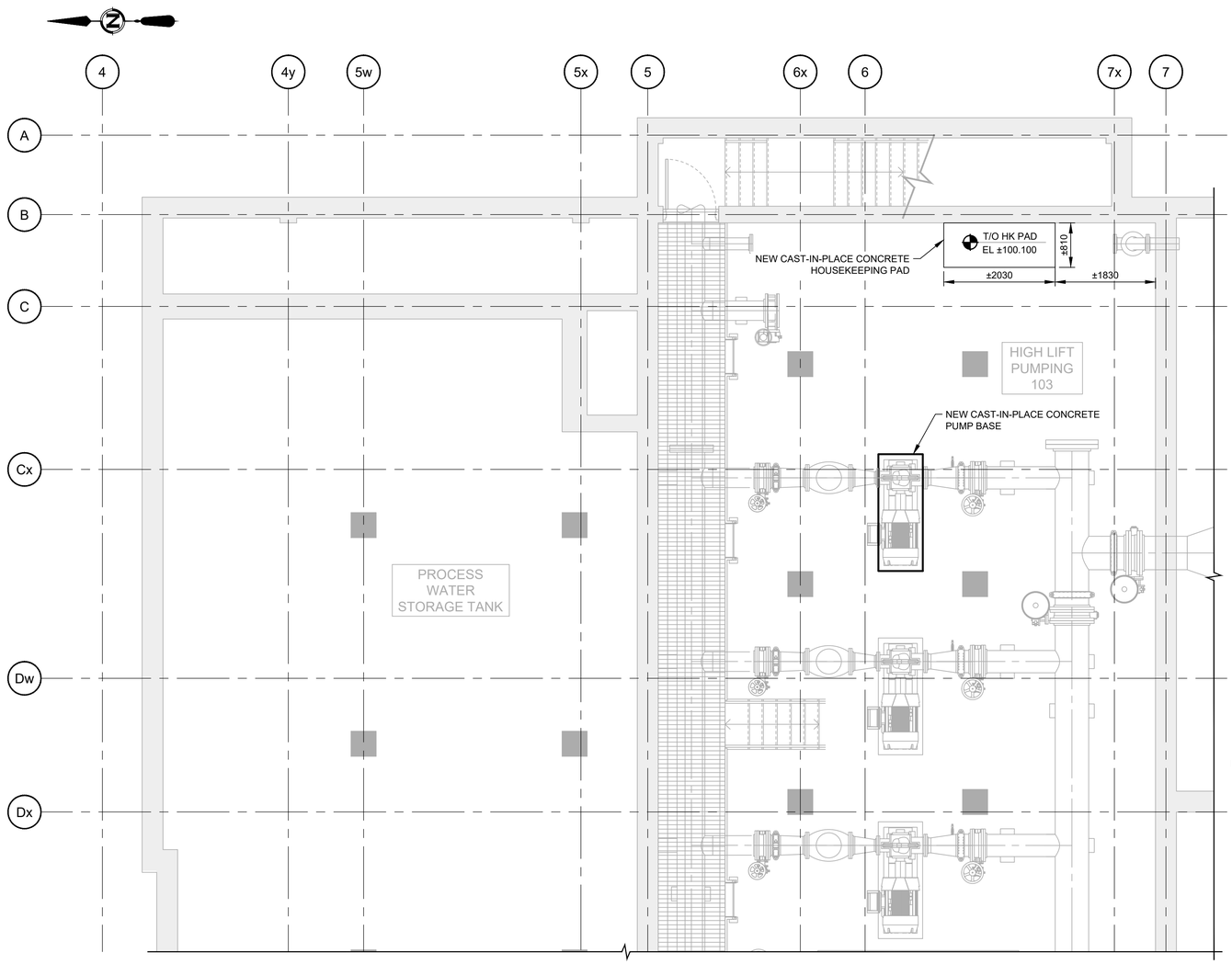


2 - DETAIL 1:20

SPLIT CASE PUMP BASE



3 - PLAN 1:50

EXISTING SUB-BASEMENT FLOOR

NOTES:

1. GENERAL

1.1. THE GENERAL NOTES AND STRUCTURAL TYPICAL DETAILS ARE GENERAL AND APPLY TO THE ENTIRE PROJECT UNLESS NOTED OTHERWISE.

1.2. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS, ELEVATIONS AND EXISTING SITE CONDITIONS PRIOR TO PROCEEDING ANY FABRICATION AND CONSTRUCTION.

1.3. DRAWINGS SHALL NOT BE SCALED.

1.4 ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE NOTED.

1.5. ALL EXISTING FACILITIES SHALL REMAIN OPERATIONAL WITHOUT PRIOR SHUT DOWN APPROVAL FROM THE CITY. IT IS CONTRACTOR'S RESPONSIBILITY TO COORDINATE WITH THE CITY TO OBTAIN A SHUT DOWN PERMIT.

1.6. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE ONTARIO OCCUPATIONAL HEALTH AND SAFETY ACT, INCLUDING ERECTION, ALTERATION, REPAIR, DISMANTLING, DEMOLITION, STRUCTURAL MAINTENANCE, PAINTING, LAND CLEARING, EARTH MOVING, GRADING, EXCAVATING, TRENCHING, DIGGING, BORING, DRILLING OR CONCRETING, INSTALLATION OF ANY MACHINERY OR PLANT AND ANY WORK OR UNDERTAKING IN CONNECTION WITH THE PROJECT.

1.7. CONTRACTOR IS RESPONSIBLE FOR RESTORATION OF ALL DISTURBED AREAS BACK TO ORIGINAL CONDITIONS OR BETTER AFTER COMPLETION OF WORK.

1.8. CONTRACTOR IS RESPONSIBLE FOR ALL TEMPORARY BRACING AND SUPPORTS FOR ALL SLABS, BEAMS, WALLS AND FRAMES. TEMPORARY BRACING AND SUPPORT MUST BE CAPABLE OF TRANSFERRING ALL IMPOSED CONSTRUCTION AND DEAD LOADS TO THE STRUCTURE WITHOUT EXCEEDING STRUCTURAL CAPACITIES.

1.9. STRUCTURAL DIMENSIONS CONTROLLED BY OR RELATED TO PROCESS, OR MECHANICAL EQUIPMENT SHALL BE VERIFIED BY CONTRACTOR PRIOR TO CONSTRUCTION.

1.10. SEE OTHER CONTRACT DRAWINGS AND COORDINATE FOR ACTUAL SIZES, LOCATIONS AND DETAILS OF OPENINGS FOR PIPES, SLEEVES, DUCTS, AND OTHER PENETRATIONS NOT SHOWN ON STRUCTURAL DRAWINGS.

1.11. TYPICAL STRUCTURAL DETAILS SHALL BE USED WHERE SPECIFIC DETAILS ARE NOT SHOWN ON STRUCTURAL DRAWINGS. IF THE DETAILS DIFFER ON OTHER DRAWINGS OR SPECIFICATIONS, THE MOST STRINGENT SHALL GOVERN.

1.12. DO NOT CUT OPENING THROUGH STRUCTURAL ELEMENTS UNLESS APPROVED BY ENGINEER.

1.13. BEFORE ANY DRILLING, CORING, CUTTING OR CHIPPING AT ANY LOCATION ARE ALLOWED TO PROCEED, THE CONTRACTOR SHOULD CONDUCT MAPPING OF REBAR & OTHER EMBEDDED ITEMS. MAPPING DOCUMENTATION SHOULD BE SUBMITTED TO ENGINEER FOR REVIEW. THE FULL COST OF MAPPING SERVICES REQUIRED ON THIS CONTRACT SHALL BE INCLUDED IN THE TOTAL CONTRACT PRICE.

1.14. SUBMIT SHOP DRAWINGS TO ENGINEER FOR REVIEW AND APPROVAL PRIOR TO FABRICATION AND INSTALLATION.

2. EXISTING STRUCTURE

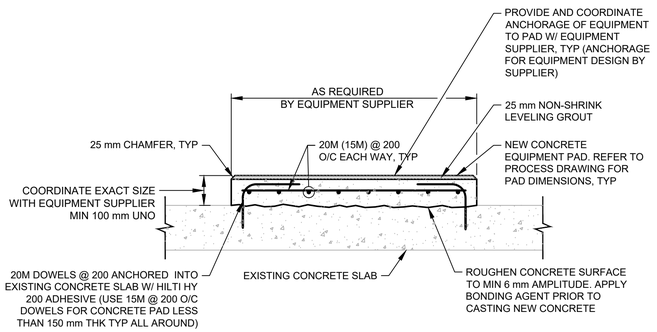
2.1. EXISTING STRUCTURAL INFORMATION IS BASED UPON AS-BUILT DRAWINGS ISSUED BY PROCTOR & REDFERN LIMITED, DATED MAY 1977.

2.2. TAKE ALL PRECAUTIONS NECESSARY TO PROTECT THE EXISTING STRUCTURE DURING CONSTRUCTION.

2.3. UNDERTAKE CHIPPING, CUTTING, CORING, REPAIRS, PATCHING, AND REMOVAL OF DEBRIS. MAKE CUTS WITH THE PROPER SAWS AND BITS WHEN A CLEAN LINE IS REQUIRED.

2.4. EXISTING DRAWINGS CONDITIONS ARE ASSUMED. REPORT ANY VARIATIONS TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

2.5. MAKE GOOD ONCE STRUCTURAL WORK IS DONE AND REVIEWED.



NOTES:

1. PAD SIZE IS SHOWN ON PROCESS DRAWING OR DETERMINED BY EQUIPMENT MANUFACTURER.
2. SIZE, NUMBER, TYPE, LOCATION AND THREAD PROJECTION OF ANCHORS SHALL BE DETERMINED BY EQUIPMENT MANUFACTURER AND SHALL BE REVIEWED BY ENGINEER. ANCHORS SHALL BE HELD IN POSITION WHILE SLAB IS BEING POURED.
3. EQUIPMENT BASES SHALL BE INSTALLED LEVELED.
4. SHIM SHALL BE USED TO SUPPORT THE BASE WHILE NON-SHRINK GROUT IS PLACED. TEMPORARY LEVELING NUTS SHALL BE BACKED OFF. IF LEFT IN, SHIMS SHALL NOT BE EXPOSED TO VIEW.

4 - DETAIL 1:20

HOUSEKEEPING PAD

Associated Engineering

CANADA'S BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
Z. Zhang
Z. ZHANG
100539351
2025-07-24
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	L. ZHANG	C. HENDRICKS	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

STRUCTURAL
EXISTING SUB-BASEMENT FLOOR PLAN
HOUSEKEEPING PAD

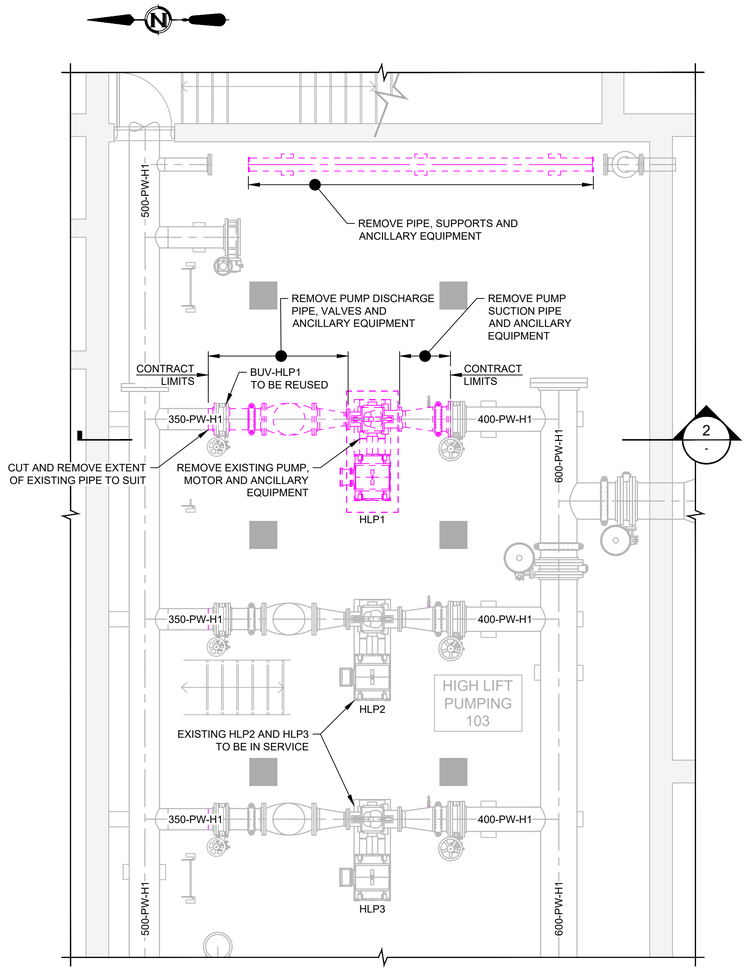
DRAWING	REVISION	SHEET
5895-01-S-101	0	7

NOTES:

1. CONTRACTOR TO CONFIRM ALL DIMENSIONS. DRAWINGS ARE BASED ON RECORD DRAWING AND ARE NOT CONSIDERED ACCURATE.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWING 5895-01-D-101 INSTALLATION PHASING.

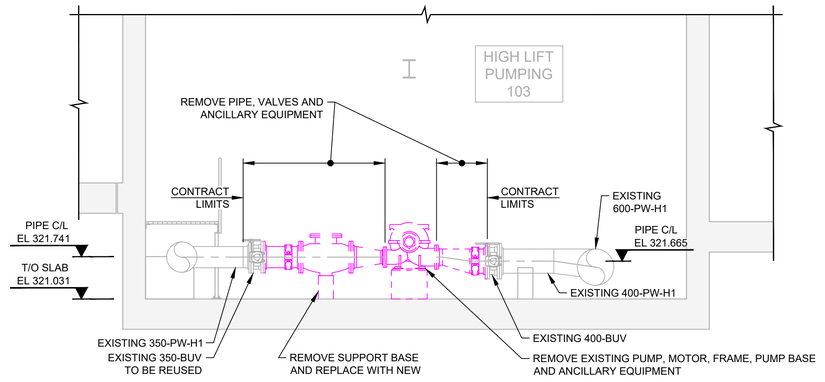
LEGEND

DEMOLITION



1 - PLAN 1:50

EXISTING SUB-BASEMENT FLOOR - DEMOLITION OF HLP1



2 - SECTION 1:50

DEMOLITION OF HLP1

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2025-07-24
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REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	K. YU	R. ZEPICK	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

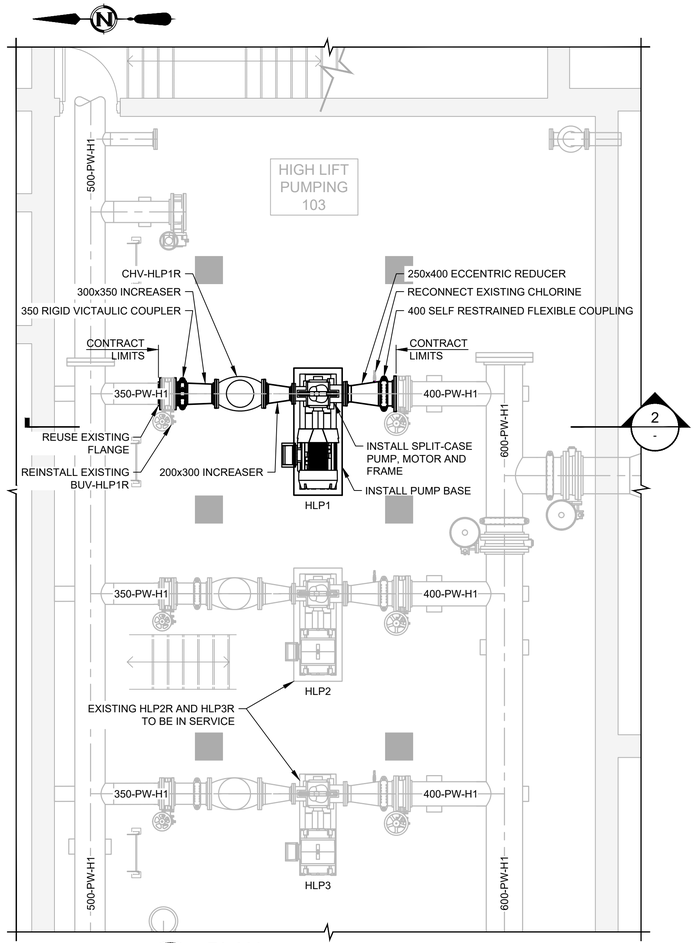
CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

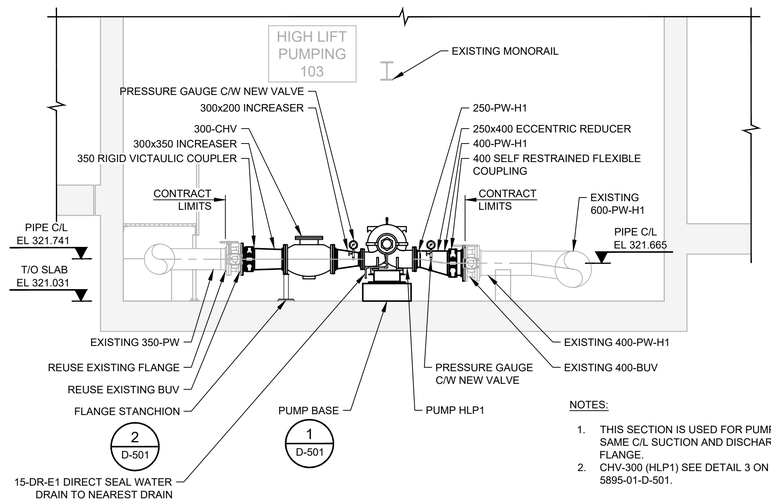
PROCESS
EXISTING SUB-BASEMENT FLOOR PLAN & SECTION
PUMP DEMOLITION - HIGH LIFT STATION

DRAWING	REVISION	SHEET
5895-01-DD-101	0	8



1 - PLAN 1:50

EXISTING SUB-BASEMENT FLOOR - INSTALLATION OF HLP1

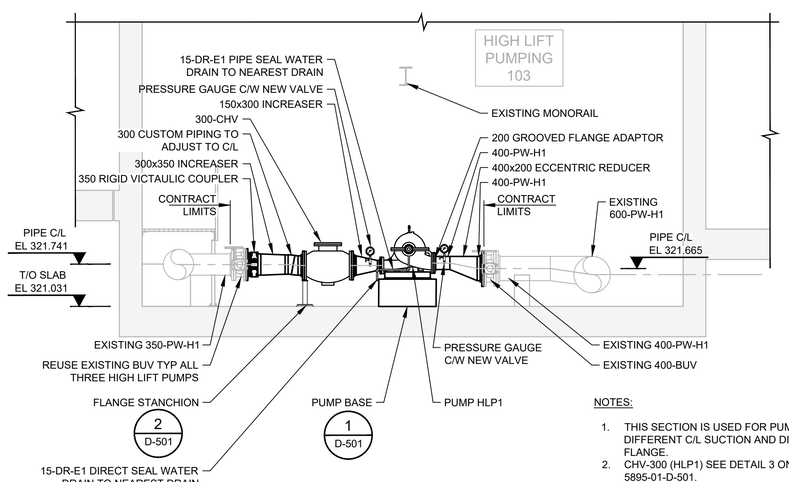


NOTES:

1. THIS SECTION IS USED FOR PUMPS WITH SAME C/L SUCTION AND DISCHARGE FLANGE.
2. CHV-300 (HLP1) SEE DETAIL 3 ON DRAWING 5895-01-D-501.

2 - SECTION 1:50

INSTALLATION OF HLP1



NOTES:

1. THIS SECTION IS USED FOR PUMPS WITH DIFFERENT C/L SUCTION AND DISCHARGE FLANGE.
2. CHV-300 (HLP1) SEE DETAIL 3 ON DRAWING 5895-01-D-501.

3 - SECTION 1:50

ALTERNATE PUMP INSTALLATION

NOTES:

1. CONTRACTOR TO CONFIRM ALL DIMENSIONS. DRAWINGS ARE BASED ON RECORD DRAWING AND ARE NOT CONSIDERED ACCURATE.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRAWING 5895-01-DD-101 DEMOLITION.
3. OVER ANGLE OF COUPLER IS NOT ACCEPTABLE.
4. CONTRACTOR RESPONSIBLE FOR PUMP BASE INFILL PER MANUFACTURER'S INSTRUCTION.
5. FOR PUMPS WITH DIFFERENT CENTERLINE SUCTION AND DISCHARGE DIMENSIONS USE SECTION 3 ON THIS DRAWING.
6. CONTRACTOR TO VERIFY ALL REDUCER/ INCREASER DIMENSIONS BASED ON THE PUMP SHOP DRAWING.

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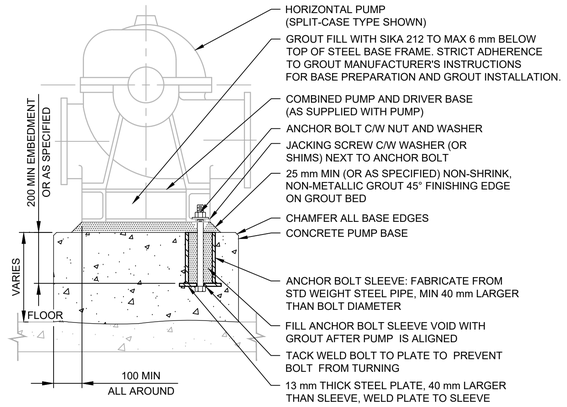
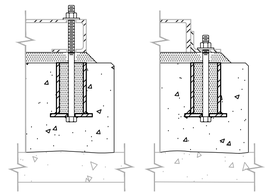
2025-5895-01

SCALE: AS SHOWN

PROCESS
EXISTING SUB-BASEMENT FLOOR PLAN & SECTIONS
PUMP INSTALLATION - HIGH LIFT STATION

DRAWING	REVISION	SHEET
5895-01-D-101	0	9



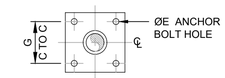


ALTERNATE STYLE PUMP BASES
C/W ANCHOR BOLT LOCATIONS

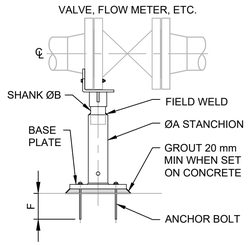
NOTES:

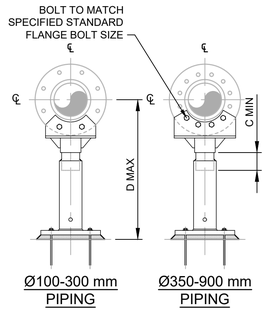
1. SS 316 ANCHOR BOLT, NUTS AND WASHERS - SIZE, NUMBER REQUIRED, THREAD PROJECTION, AND LENGTH TO SUIT PUMP MANUFACTURERS' SPECIFICATIONS.
2. JACKING NUTS MAY BE REPLACED WITH LEVELING SHIMS. SHIMS ARE TO REMAIN IN PLACE, THEN PLACE GROUT.

1 TYPICAL DETAIL NTS
SPLIT CASE PUMP BASE ANCHOR



BASE PLATE PLAN



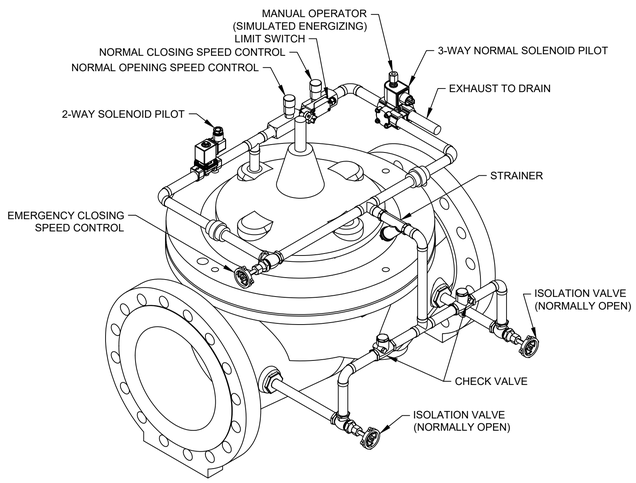


NOTES:

1. ALL MATERIAL SHALL BE 316 SS OR AS SPECIFIED.
2. ACCEPTABLE BASE STAND: B-LINE B3088, ANVIL FIG.63, OR EQUAL.
3. ACCEPTABLE FLANGE SUPPORT: B-LINE B3094, OR EQUAL.
4. PROVIDE ISOLATION BETWEEN DISSIMLAR METALS.

NOM PIPE DIA	100	125	150	200	250	300	350	400	450	500	600	750	900
A (ND)	65						80		100				
B (OD)	60						73		95				
C Min	50					80			100				
D Max	1200								1850				
BASE PLATE	200x200x10 mm						300x300x10 mm		300x300x15 mm				
HOLES #xE	4xØ21 mm BOLT HOLES								4xØ24 mm BOLT HOLES				
BOLT ØxF	M20X100								M24X100				
	BOLT SHALL BE SS 316, OR AS APPROVED EXIST. CONCRETE USE HEAVY-DUTY EXPANSION ANCHOR												

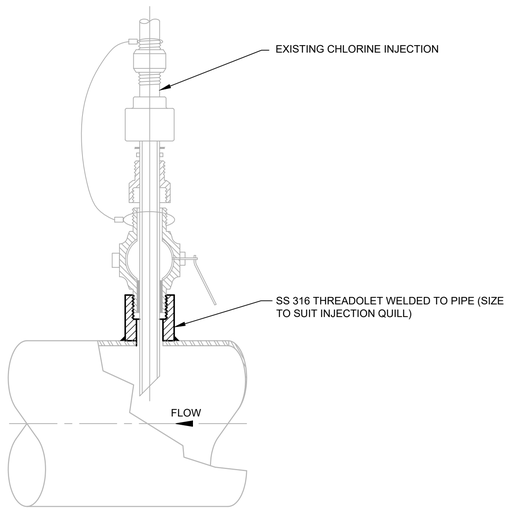
2 TYPICAL DETAIL NTS
BASE SUPPORT STANCHION (ADJUSTABLE) WITH FLANGE SUPPORT



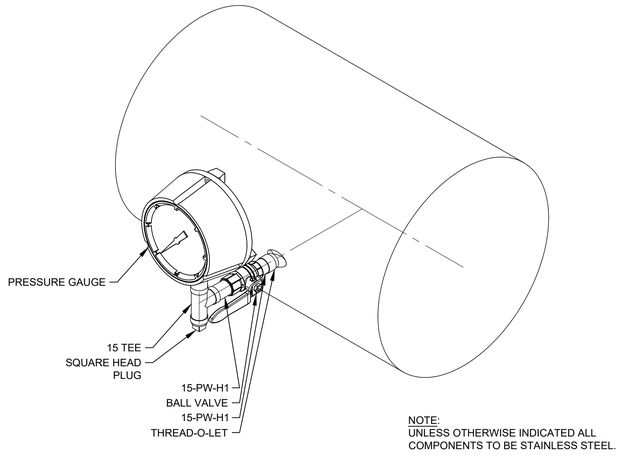
NOTES:

1. PILOT PIPING TO BE TYPE K COPPER WITH PRESS FIT FITTINGS.
2. DRAWING IS FOR REFERENCE ONLY. THE FINAL PRODUCT SHALL BE APPROVED BY ENGINEER THROUGH SHOP DRAWING.

3 TYPICAL DETAIL NTS
ELECTRIC CHECK VALVE



4 TYPICAL DETAIL NTS
PIPING ASSEMBLY - CHEMICAL INJECTION QUILL



NOTE:
UNLESS OTHERWISE INDICATED ALL COMPONENTS TO BE STAINLESS STEEL.

5 TYPICAL DETAIL NTS
POTABLE WATER PRESSURE GAUGE

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2025-5895-01

SCALE: AS SHOWN

PROCESS
DETAILS

DRAWING	REVISION	SHEET
5895-01-D-501	0	10

IF NOT 50 mm ADJUST SCALES 50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

LAYOUT SYMBOLS

CABLE, CONDUIT & WIRE

- CONDUIT RUN ON SURFACE (WALL OR CEILING)
- CONDUIT RUN IN SLAB (OR BELOW GRADE)
- CONDUIT CAPPED
- CONDUIT GOING UP
- CONDUIT GOING DOWN
- FLEXIBLE CONDUIT
- CONDUIT HOME RUN c/w NUMBER OF WIRES
- CONDUIT SEAL WP-WEATHERPROOF, EP-EXPLOSION PROOF
- CONDUIT UNION
- CONDUIT EXPANSION JOINT
- CONDUIT BEND
- BARE GROUND WIRE
- OVERHEAD POWER SERVICE ENTRANCE
- OVERHEAD TELEPHONE SERVICE ENTRANCE
- JUNCTION BOX - CEILING SPACE
- JUNCTION BOX - FLUSH MOUNTED
- JUNCTION BOX - WALL MOUNTED
- JUNCTION BOX - MOTOR / EQUIPMENT
- MULTI-CABLE TRANSIT (MCT)
- SPARE WIRE LOOP
- CABLE OR CONDUIT DESIGNATION (PC-101): PC-POWER, TC-TELEPHONE, CC-CONTROL, IC-INSTRUMENTATION, HC-HEATING
- A10-b — PANEL "A", CIRCUIT "10", SWITCH "b"

POWER

- XFMR — POWER TRANSFORMER
- PNL "A" — MAIN DISTRIBUTION PANEL "A"
- PNL "A" — LIGHTING OR BRANCH PANEL "A"
- SPLTR — SPLITTER
- MUA2D 5005 — MOTOR AND/OR EQUIPMENT TAG c/w NAME, PLANT AREA & NUMBER
- M — MOTOR
- D — MOTORIZED DAMPER
- MOV — MOTOR OPERATED VALVE
- SOV — SOLENOID OPERATED VALVE
- ELECTRIC HEATER
- CHEMICAL PUMP RECEPTACLE
- DUPLEX RECEPTACLE
- SPLIT DUPLEX RECEPTACLE
- ISOLATED GROUND RECEPTACLE
- GROUND FAULT (GFCI) RECEPTACLE
- ABOVE COUNTER DUPLEX RECEPTACLE
- ABOVE COUNTER SPLIT DUPLEX RECEPTACLE
- ABOVE COUNTER GROUND FAULT (GFCI) RECEPTACLE
- FLOOR MOUNTED SINGLE RECEPTACLE
- FLOOR MOUNTED DUPLEX RECEPTACLE
- SPECIAL SINGLE PHASE RECEPTACLE
- SPECIAL THREE PHASE RECEPTACLE
- OVERHEAD REEL DUPLEX RECEPTACLE
- SINGLE PHASE POWER CONNECTION
- THREE PHASE POWER CONNECTION
- W — WELDING RECEPTACLE

LIGHTING

- A — FIXTURE TYPE "A"
- SURFACE MOUNTED OR SUSPENDED FLUORESCENT FIXTURE
- RECESSED FLUORESCENT FIXTURE
- SURFACE MOUNTED OR SUSPENDED 610 x 610 FLUORESCENT FIXTURE
- RECESSED 610 x 610 FLUORESCENT FIXTURE
- FLUORESCENT STRIP FIXTURE
- WALL MOUNTED FLUORESCENT FIXTURE
- SURFACE MOUNTED OR SUSPENDED UNSWITCHED FLUORESCENT FIXTURE
- RECESSED UNSWITCHED FLUORESCENT FIXTURE
- AREA LIGHTING FIXTURE
- SURFACE MOUNTED OR SUSPENDED LUMINAIRE
- LUMINAIRE ON EMERGENCY POWER
- RECESSED LUMINAIRE
- RECESSED LUMINAIRE ON EMERGENCY POWER
- WALL MOUNTED LUMINAIRE
- POLE MOUNTED LUMINAIRE
- CEILING MOUNTED EXIT SIGN c/w DIRECTION ARROW
- WALL MOUNTED EXIT SIGN c/w DIRECTION ARROW
- TENON MOUNTED LUMINAIRE
- EMERGENCY LIGHTING UNIT c/w BATTERY PACK, CHARGER AND TWO HEADS
- WALL MOUNTED SINGLE EMERGENCY LIGHTING HEAD c/w JUNCTION BOX
- WALL MOUNTED DOUBLE EMERGENCY LIGHTING HEAD c/w JUNCTION BOX
- B — 1 LAMP BALLAST (REMOTE MOUNTED)
- 2 LAMP BALLAST (REMOTE MOUNTED)

FIRE ALARM

- FIRE ALARM PANEL AND/OR ANNUNCIATOR
- F or PS — BREAK GLASS STATION
- F — FIRE ALARM BELL
- F cd — FIRE ALARM HORN AND STROBE c/w CANDELA LEVEL
- F — FIRE ALARM PHONE
- F — FIRE ALARM SPEAKER
- SMOKE DETECTOR
- SMOKE DETECTOR - DUCT MOUNTED
- COMBINATION HEAT DETECTOR
- HEAT DETECTOR - FIXED TEMPERATURE
- HEAT DETECTOR - RATE-OF-RISE
- F cd — FIRE ALARM STROBE LIGHT c/w CANDELA LEVEL
- END-OF-LINE RESISTOR
- FS — FLOW SWITCH
- PS — PRESSURE SWITCH
- Z — TAMPER SWITCH
- G — GAS DETECTOR
- IN — INFRARED DETECTOR
- U — ULTRAVIOLET DETECTOR
- D — MAGNETIC DOOR RELEASE
- L — ELECTRIC DOOR LOCK
- F — PRE-SIGNAL BUZZER
- CR — CONTROL RELAY MODULE
- I — ISOLATOR BASE MODULE
- ARM — ADDRESSABLE ALARM RELAY MODULE

ABBREVIATIONS

BD	- BUS DUCT
CB	- CIRCUIT BREAKER
DB	- DUCT BANK
DS	- DISCONNECT SWITCH
MCC	- MOTOR CONTROL CENTRE
PDP	- POWER DISTRIBUTION PANEL
PNL	- BRANCH PANEL BOARD
SWB	- SWITCHBOARD
T	- TRANSFORMER
UPS	- UNINTERRUPTIBLE POWER SUPPLY

NOTE:

1. THIS DRAWING IS GENERAL IN NATURE. NOT ALL SYMBOLS, ABBREVIATIONS ARE USED IN THESE CONTRACT DRAWINGS.

COMMUNICATIONS

- TTB — TELEPHONE TERMINAL BOARD
- TELEPHONE OUTLET - WALL MOUNTED
- TELEPHONE OUTLET - FLOOR MOUNTED
- INTERCOM HANDSET OUTLET - WALL MOUNTED
- ITS LAN DATA OUTLET
- COMBINATION DATA/TELEPHONE OUTLET
- WiFi — WIFI CONNECTION POINT
- S — SPEAKER - CEILING MOUNTED
- S — SPEAKER - WALL MOUNTED

GROUNDING

- GROUND BUS
- GROUND COMPRESSION CONNECTION
- EQUIPMENT GROUND CONNECTION
- THERMIT WELD GROUND CONNECTION
- GROUND ROD
- GROUND WELL & ROD
- GROUND GRID w/ WELLS & RODS

SECURITY

- CARD READER
- SINGLE DOOR ALARM CONTACT
- MOTION DETECTOR
- C P — SECURITY CAMERA - CEILING MOUNTED

CONTROL

- Ax a — SINGLE POLE SWITCH (SWITCH "a") PANEL "A" CIRCUIT "x"
- (2) — 2 SWITCHES IN 2 GANG BOX
- (3) — 3 SWITCHES IN 3 GANG BOX
- (4) — 4 SWITCHES IN 4 GANG BOX
- 2 — TWO POLE SWITCH
- 3 — THREE WAY SWITCH
- 4 — FOUR WAY SWITCH
- X — SWITCH c/w PILOT LIGHT
- M — MANUAL MOTOR SWITCH
- M — MANUAL MOTOR SWITCH c/w PILOT LIGHT
- K — KEY OPERATED SWITCH
- EP — EXPLOSION PROOF SWITCH
- WP — WEATHERPROOF SWITCH
- a — LOW VOLTAGE SWITCH (CIRCUIT "a")
- K-P — LOW VOLTAGE SWITCH (K-KEY OPERATED, P-PILOT LIGHT)
- DIMMER SWITCH/ FAN SPEED CONTROL
- SPECIAL LOW VOLTAGE SWITCH UNIT (SEE SPECIFICATIONS)
- RC — LOW VOLTAGE SWITCHING RELAY CABINET
- M — MOTION SENSOR SWITCH
- P — PHOTOELECTRIC CELL
- DISCONNECT SWITCH - FUSED
- DISCONNECT SWITCH - UNFUSED
- MANUAL MOTOR STARTER
- MAGNETIC MOTOR STARTER
- COMBINATION MAGNETIC STARTER
- T — LOW VOLTAGE THERMOSTAT
- T — LINE VOLTAGE THERMOSTAT
- H — HUMIDSTAT
- OI — ON-OFF CONTROL STATION
- HOA — HAND-OFF-AUTO SELECTOR SWITCH
- LO — LOCKOUT STOP CONTROL STATION
- LOR — LOCAL-OFF-REMOTE CONTROL STATION
- SELECTOR SWITCH (HOA, LOR, LO or OA)
- START-STOP PUSHBUTTON AND SELECTOR SWITCH (HOA, LOR, LO or OA)
- LOS — LOCKOUT STOP PUSHBUTTON
- START-STOP PUSHBUTTON
- START-STOP PUSHBUTTON c/w PILOT LIGHT & LOCKOUT STOP
- START-JOG-STOP PUSHBUTTON
- ESD — EMERGENCY SHUTDOWN PUSHBUTTON
- THERMISTOR CONTROL TRIPPING UNIT
- TS — TIME SWITCH
- XX — LOW VOLTAGE TRANSFORMER (XX=TRANSFORMER NUMBER)

SINGLE LINE DIAGRAM / SCHEMATIC SYMBOLS

- EQUIPMENT BUS
- BUS EXTENSION / CONNECTION
- 52 — 4160 V, 1200 A, 150 MVA — POWER CIRCUIT BREAKER
- 52 — 4160 V, 1200 A, 150 MVA — DRAWOUT POWER CIRCUIT BREAKER
- AS — AMMETER SWITCH
- VS — VOLTMETER
- TD — TRANSDUCER
- XXX:X — CURRENT TRANSFORMER c/w RATIO & QUANTITY
- XXX:X QTY — ZERO SEQUENCING CURRENT TRANSFORMER c/w RATIO & QUANTITY
- QTY — BUSHING TYPE CURRENT TRANSFORMER c/w RATIO & QUANTITY
- V-V QTY — POTENTIAL TRANSFORMER c/w VOLTAGE RATING & QUANTITY
- K — KEY OPERATED INTERLOCK
- M — MOTOR OPERATED SWITCH
- DMS — DIGITAL METERING SYSTEM
- M — UTILITY POWER METER
- LIGHTNING ARRESTER w/ GROUNDED GAP
- LIGHTNING ARRESTER w/ GROUNDED GAP AND SURGE CAPACITOR
- V-V — DRAWOUT FUSED CURRENT TRANSFORMER
- A — DELTA-DELTA TRANSFORMER
- DELTA-WYE GROUND TRANSFORMER
- DELTA-WYE RESISTOR GROUND TRANSFORMER
- OPEN DELTA
- CLOSED DELTA
- THREE PHASE WYE
- THREE PHASE WYE TO GROUND
- THREE PHASE ZIGZAG TO GROUND
- THREE PHASE WYE w/ RESISTOR TO GROUND
- MALE & FEMALE DISCONNECT DEVICE
- 100AT 225AF, 3P — CIRCUIT BREAKER
- 100AT 225AF, 3P — DRAWOUT CIRCUIT BREAKER
- NON-FUSED DISCONNECT SWITCH
- FUSED DISCONNECT SWITCH
- FUSED HRC DISCONNECT SWITCH
- LOAD BREAK DISCONNECT SWITCH
- FUSED LOAD BREAK DISCONNECT SWITCH
- HORN GAP SWITCH
- INTERRUPTER SWITCH
- FUSED INTERRUPTER SWITCH
- GROUND SWITCH
- MAGNETIC ELEMENT
- kVAR — CAPACITOR FOR PF CORRECTION c/w kVAR RATING
- NORMALLY OPEN CONTACT
- NORMALLY CLOSED CONTACT
- PLC — PROGRAMMABLE LOGIC CONTROLLER
- REACTOR
- HARMONIC FILTER
- or — TRANSFER SWITCH
- FLEX CONNECTOR
- J — JUNCTION BOX MOUNTED NEAR MOTOR

- RTD — RESISTANCE TEMPERATURE DETECTOR
- 1 — FVNR MAGNETIC STARTER c/w SIZE
- 1 1 — FVR (REVERSING) STARTER c/w SIZE
- 1 1 — TWO SPEED STARTER c/w SIZE
- O/L — THERMAL OVERLOAD RELAY
- X:X X — ELECTRONIC OVERLOAD c/w RATIO & QUANTITY
- HZ — VARIABLE SPEED DRIVE
- S/S — SOFT START REDUCED VOLTAGE
- GENERATOR
- HP — SQUIRREL CAGE MOTOR
- HP — MOTORIZED VALVE
- LIGHTING OR POWER PANEL
- PANEL 'A'
- VALVE TRAVEL LIMIT SWITCH-NORMALLY OPEN
- VALVE TRAVEL LIMIT SWITCH-NORMALLY CLOSED
- SPECIAL SINGLE PHASE RECEPTACLE
- SPECIAL THREE PHASE RECEPTACLE
- W — WELDING RECEPTACLE
- X kW — MOTOR SPACE HEATER
- SOLID STATE SURGE ARRESTER
- TVSS — TRANSIENT VOLTAGE SURGE SUPPRESSION
- CTS — CURRENT TRANSFORMER SHORTING BLOCK
- 29-1 — PT-CT TEST BLOCK
- B — TEST BLOCK
- GROUND TO EARTH
- BATTERY
- 50 QTY — PROTECTIVE RELAY c/w QUANTITY (1 LINE)
- 50 5T QTY — PROTECTIVE RELAY c/w QUANTITY (2 LINE)
- RELAY SHUNT
- H1 H2 XXX XXX X1 X2 — CONTROL POWER TRANSFORMER
- X HP — SINGLE or THREE PHASE MOTOR
- MOV — MOTOR OPERATED VALVE
- R101 — RELAY COIL (1 LINE)
- R 101 — RELAY COIL (2 LINE)
- R 4RT 101 — RELAY COIL (3 LINE)
- TD — TD 0-30 SECS — TIMING RELAY COIL w/ TDE -TIME DELAY ENERGIZED, TDD -TIME DELAY DE-ENERGIZED & TIME RANGE
- LC — LIGHTING CONTACTOR COIL
- M — MOTOR STARTER COIL
- CR — CONTROL RELAY
- RA — AUXILIARY RELAY
- PFR — POWER FAILURE RELAY
- OTR — OVERLOAD TRIP RELAY

- CC — CLOSING COIL
- HC — HOLDING COIL
- A — INDICATING PILOT LIGHT c/w LENS COLOR R=RED, G=GREEN, A=AMBER, Y=YELLOW, W=WHITE
- ETM — ELAPSED TIME METER
- O/L — MOTOR OVERLOAD CONTACT
- TEST SUPPLY PLUG
- X A — FUSE c/w FUSE No. or AMP RATING
- DUMMY FUSE
- X kW HTR — ELECTRIC HEATER c/w KILOWATT RATING
- X kW — MOTOR SPACE HEATER c/w KILOWATT RATING
- X OHMS — RESISTOR c/w RESISTANCE RATING
- SERIES COIL OR SOLENOID VALVE
- TC — TEMPERATURE CONTROLLER
- SURGE SUPPRESSOR
- SUPPRESSOR M — MOTOR SURGE SUPPRESSOR
- X X A — FUSE ASSEMBLY w/ INDICATING LIGHT c/w FUSE NUMBER AND CURRENT RATING
- G — INDICATING LIGHT PUSH TO TEST c/w COLOR TYPE
- SEMICONDUCTOR DIODE
- 113 — WIRE WITH WIRE NUMBERS
- MECHANICAL CONNECTION
- WIRES CROSSOVER
- WIRES CONNECTED
- FIELD CONNECTION
- NORMALLY CLOSED MUSHROOM HEAD PUSHBUTTON - MOMENTARY
- NORMALLY OPEN PUSHBUTTON - MOMENTARY
- NORMALLY CLOSED PUSHBUTTON - MOMENTARY
- THREE POLE CIRCUIT BREAKER (CONTROL SCHEMATIC ONLY)
- THREE POLE DISCONNECT SWITCH (CONTROL SCHEMATIC ONLY)
- SINGLE POLE SINGLE THROW DISCONNECT SWITCH
- SINGLE POLE DOUBLE THROW DISCONNECT SWITCH
- ON OFF — TWO (2) POSITION SELECTOR SWITCH (ON-OFF SWITCH SHOWN IN ON POSITION)
- H A O — THREE (3) POSITION SELECTOR SWITCH (HAND-OFF-AUTO SHOWN IN HAND POSITION)
- C 1 2 — DUAL TRANSFER SWITCH
- 3 — FLOW SWITCH NORMALLY OPEN OR CLOSED
- LEVEL SWITCH NORMALLY OPEN OR CLOSED
- LIMIT SWITCH NORMALLY OPEN OR CLOSED
- PRESSURE SWITCH NORMALLY OPEN OR CLOSED
- TEMPERATURE SWITCH NORMALLY OPEN OR CLOSED
- TERMINALS - TYPE AND LOCATION ASSIGNMENT DESIGNATED BY PROJECT DESIGN

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LICENSED PROFESSIONAL ENGINEER — S. B. FRIEL 100605345 — PROVINCE OF ONTARIO — 2025-07-23

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	S. FRIEL	A. JAEB	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

ELECTRICAL
LEGEND

DRAWING	REVISION	SHEET
5895-01-E-001	0	11

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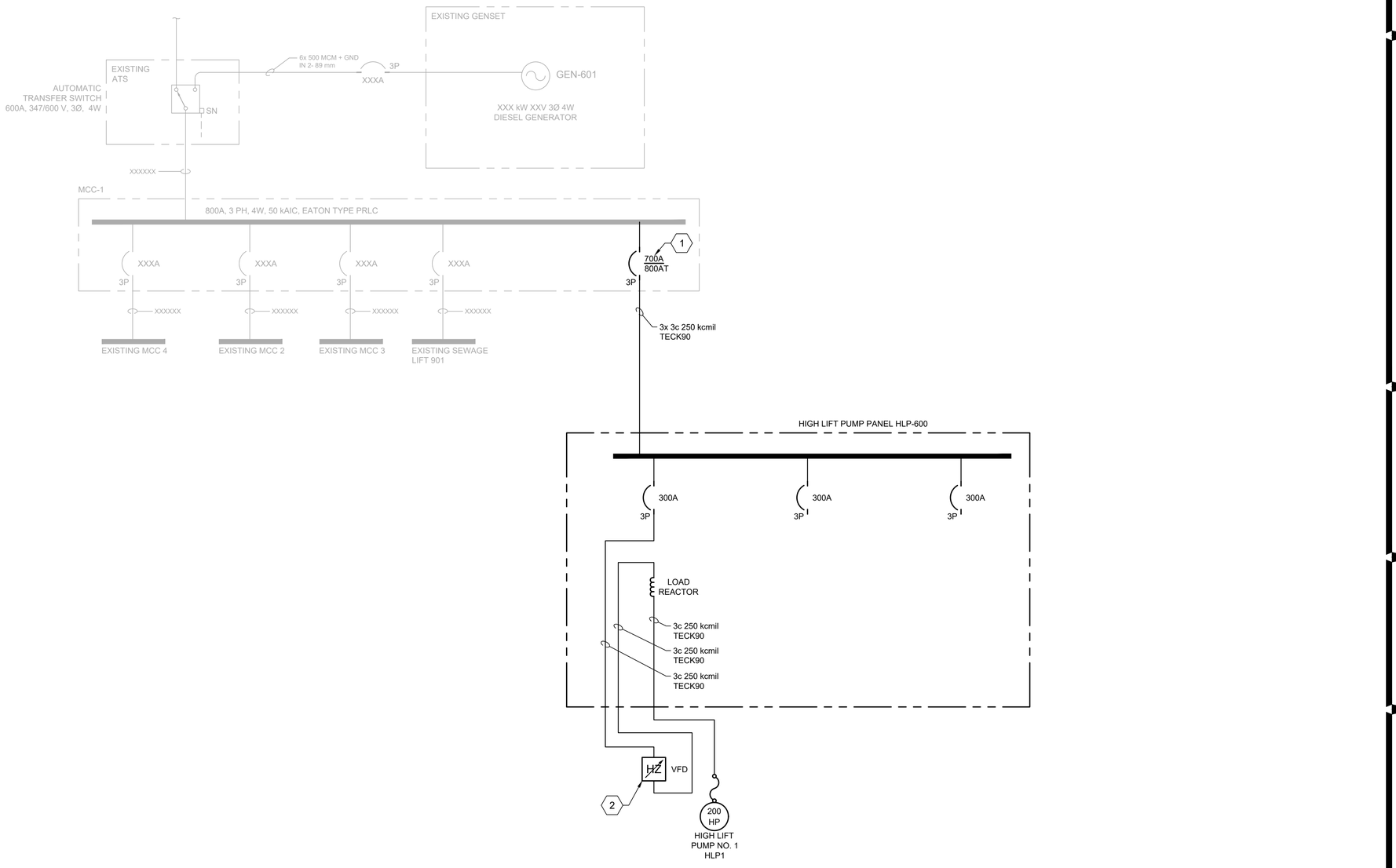
IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

KEYNOTES

TAG	DESCRIPTION
1	PROVIDE EATON KDC BREAKER FOR HLP CONTROL PANEL.
2	VFD SHALL BE LOW HARMONICS. IF THE CONTRACTOR PROVIDES AN ALTERNATIVE VFD MODEL THAT IS NOT LOW HARMONICS, AN ADDITIONAL BREAKER AND ACTIVE HARMONIC CORRECTION UNIT WILL NEED TO BE PROVIDED FOR THE ULTIMATE BUILD OUT.



1 / E-011 DIAGRAM — SINGLE LINE — NTS

Associated Engineering

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Platinum member

LICENSED PROFESSIONAL ENGINEER
S. B. FRIEL
100075345
PROVINCE OF ONTARIO
2025-07-23

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0	2025JUL14	S. FRIEL	A. JAEB	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

ELECTRICAL
SINGLE LINE DIAGRAM
MCC AND VFD PANEL

DRAWING	REVISION	SHEET
5895-01-E-011	0	12

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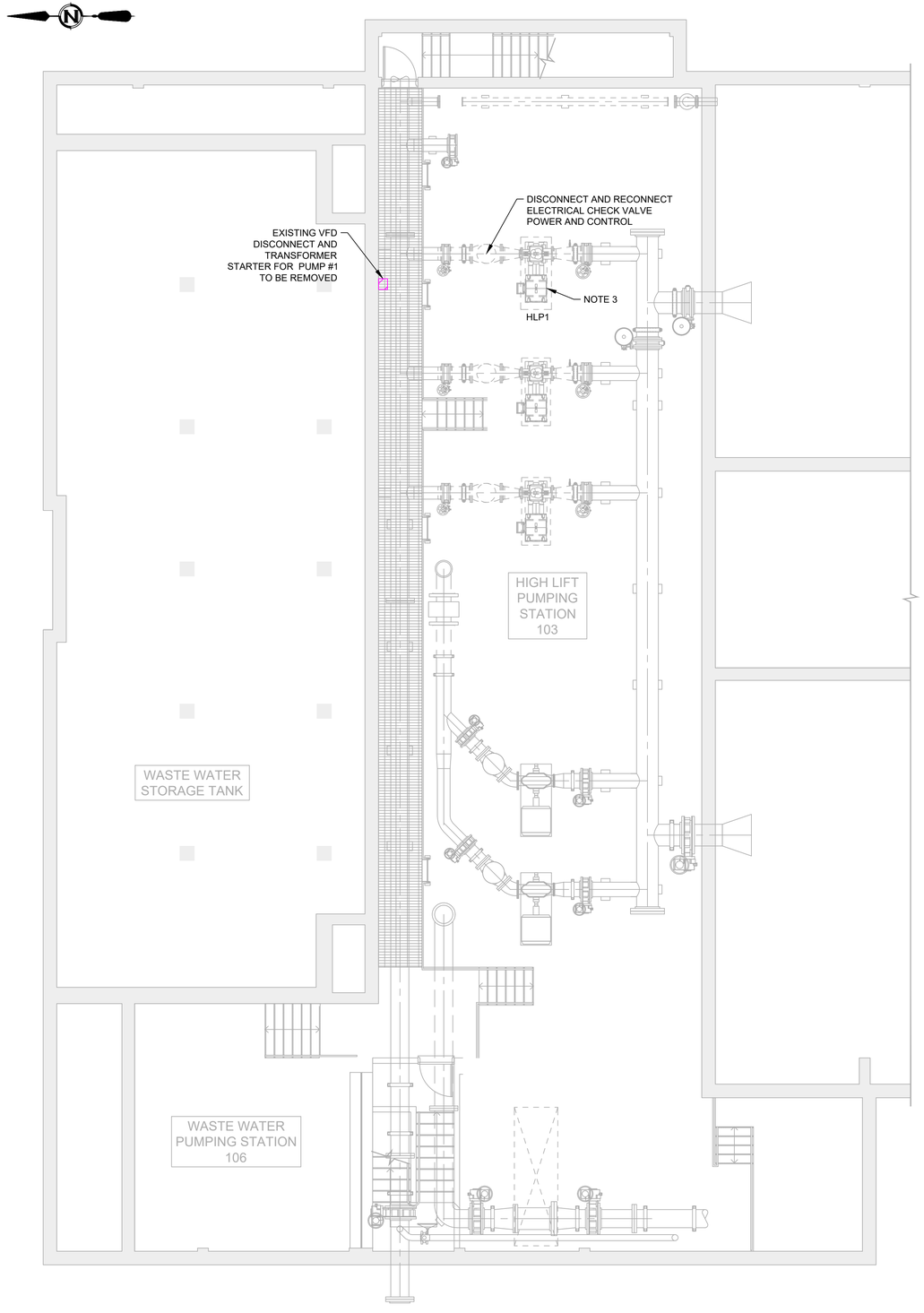

1 ED-101 PLAN 1:75

EXISTING SUB-BASEMENT FLOOR - DEMO

NOTES:

1. DISPOSAL OF MATERIALS TO BE AT AN APPROVED DISPOSAL FACILITY AS PER SPECIFICATIONS.
2. CONTRACTOR TO CONFIRM ALL EQUIPMENT. DRAWINGS ARE BASED ON RECORD DRAWING AND ARE NOT CONSIDERED ACCURATE.
3. REMOVE FEEDERS FROM MOTORS TO MCC, ATTACH PULL MULE CABLE TO BE LEFT IN CONDUIT. IF SUCCESSFULLY REMOVED, NOTIFY ENGINEER. IF CABLE CANNOT BE REMOVED, ABANDON REMAINING LENGTH. CUT BACK CABLES AND FILL CONDUIT OPENING WITH NON-SHRINK GROUT WITH MINIMUM 50 mm DEPTH.

LEGEND

DEMOLITION

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S. B. FRIEL
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PROVINCE OF ONTARIO
2025-07-23

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CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

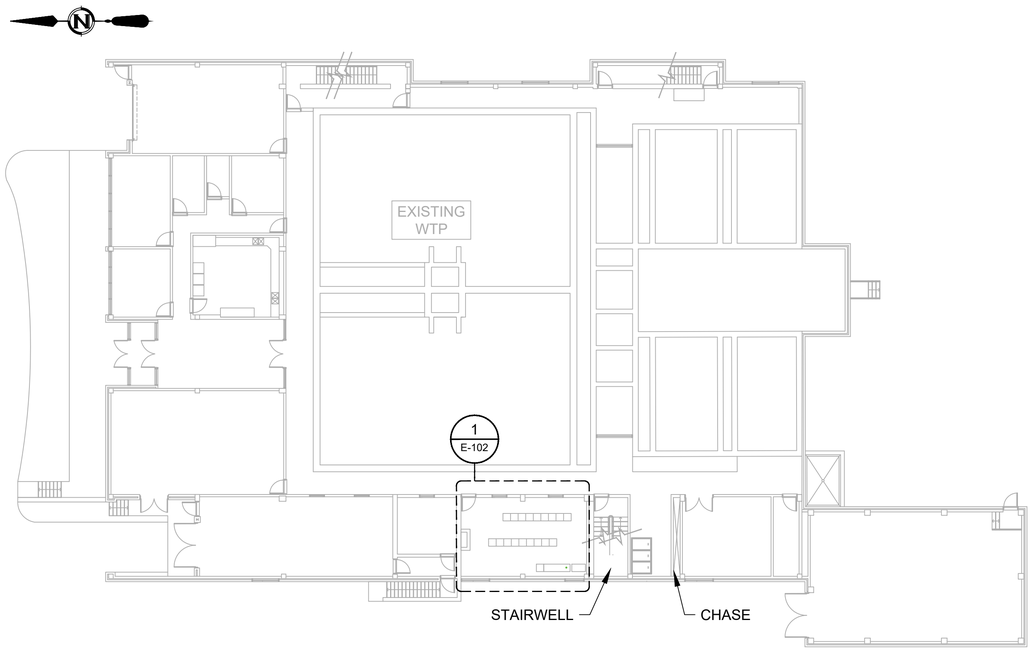
SCALE: AS SHOWN

ELECTRICAL
EXISTING SUB-BASEMENT FLOOR PLAN
DEMOLITION

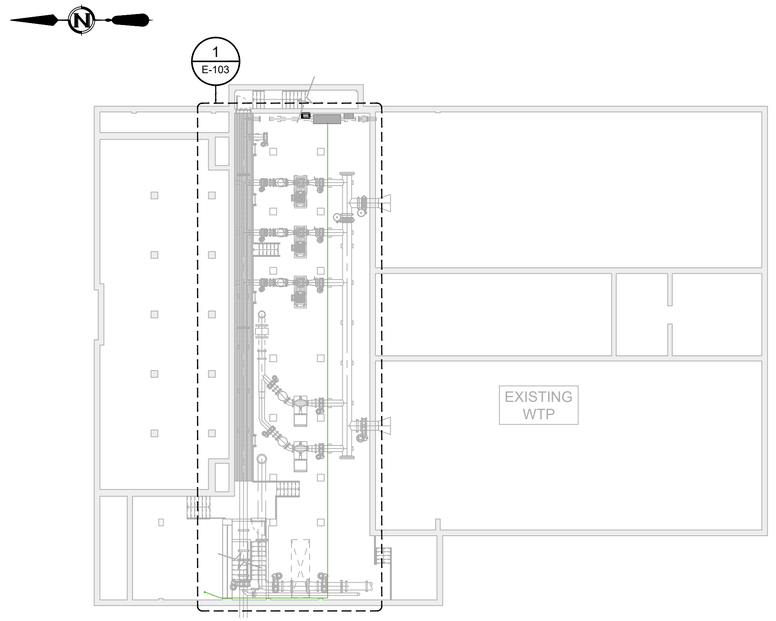
DRAWING	REVISION	SHEET
5895-01-ED-101	0	13

NOTES:

1. CHASE MAY BE USED FOR ROUTING BETWEEN ROOM 311 AND SUB-BASEMENT.
2. STAIRWELL CANNOT BE USED FOR ROUTING.



1 E-101 PLAN 1:200
EXISTING MAIN FLOOR



2 E-101 PLAN 1:200
EXISTING SUB-BASEMENT FLOOR

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LICENSED PROFESSIONAL ENGINEER
S. B. FRIEL
100605345
PROVINCE OF ONTARIO
2025-07-23

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CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

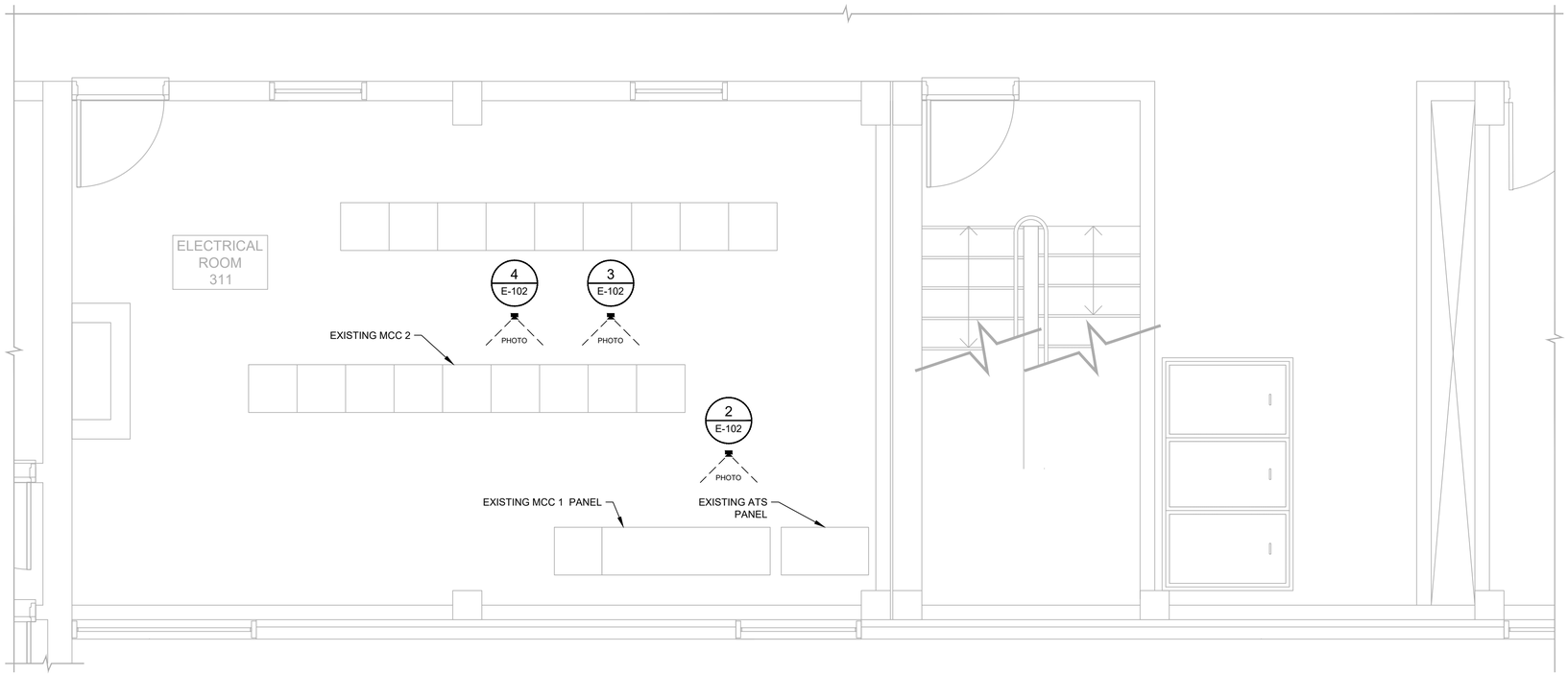
SCALE: AS SHOWN

ELECTRICAL
EXISTING MAIN AND SUB-BASEMENT FLOOR PLANS

DRAWING	REVISION	SHEET
5895-01-E-101	0	14

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 E-102 **PLAN** 1:30

EXISTING MAIN FLOOR - ELECTRICAL ROOM

NOTES:

1. MCC 1 IS AN EATON 900 SWITCHGEAR.
2. DEMOLISH HLP1, EMPTY MCC BUCKET, STARTERS AND ASSOCIATED CABLES. INSTALL STEEL PLATE TO MATCH EXISTING PANEL THAT COVERS HOLES. MCC SECTIONS TO REMAIN.
3. DO NOT DRILL THROUGH PRECAST CONCRETE.
4. STAIRWELL CANNOT BE USED FOR ROUTING.

LEGEND

DEMOLITION

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ADD NEW BREAKERS IN EXISTING MCC 1 PANEL AND CONNECT WITH NEW WIRING IN CONDUIT TO FEED HLP-600, NOTE 1

1 E-011

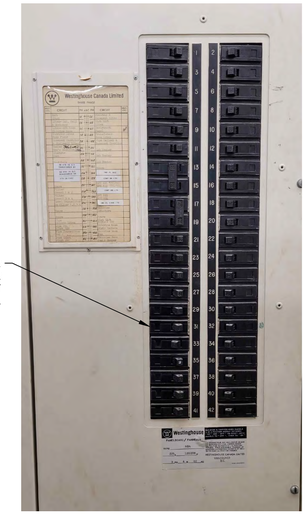
2 E-102 **PHOTO** NTS

EXISTING MCC 1

3 E-102 **PHOTO** NTS

EXISTING MCC 2

SPARE 20 A BREAKER FOR 120 VAC POWER TO SUB-BASEMENT REMOTE IO PANEL



4 E-102 **PHOTO** NTS

EXISTING LP "E"

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	S. FRIEL	A. JAEB	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

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2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

ELECTRICAL
EXISTING MAIN FLOOR PLAN AND PHOTOS
ELECTRICAL ROOM MCC

DRAWING	REVISION	SHEET
5895-01-E-102	0	15

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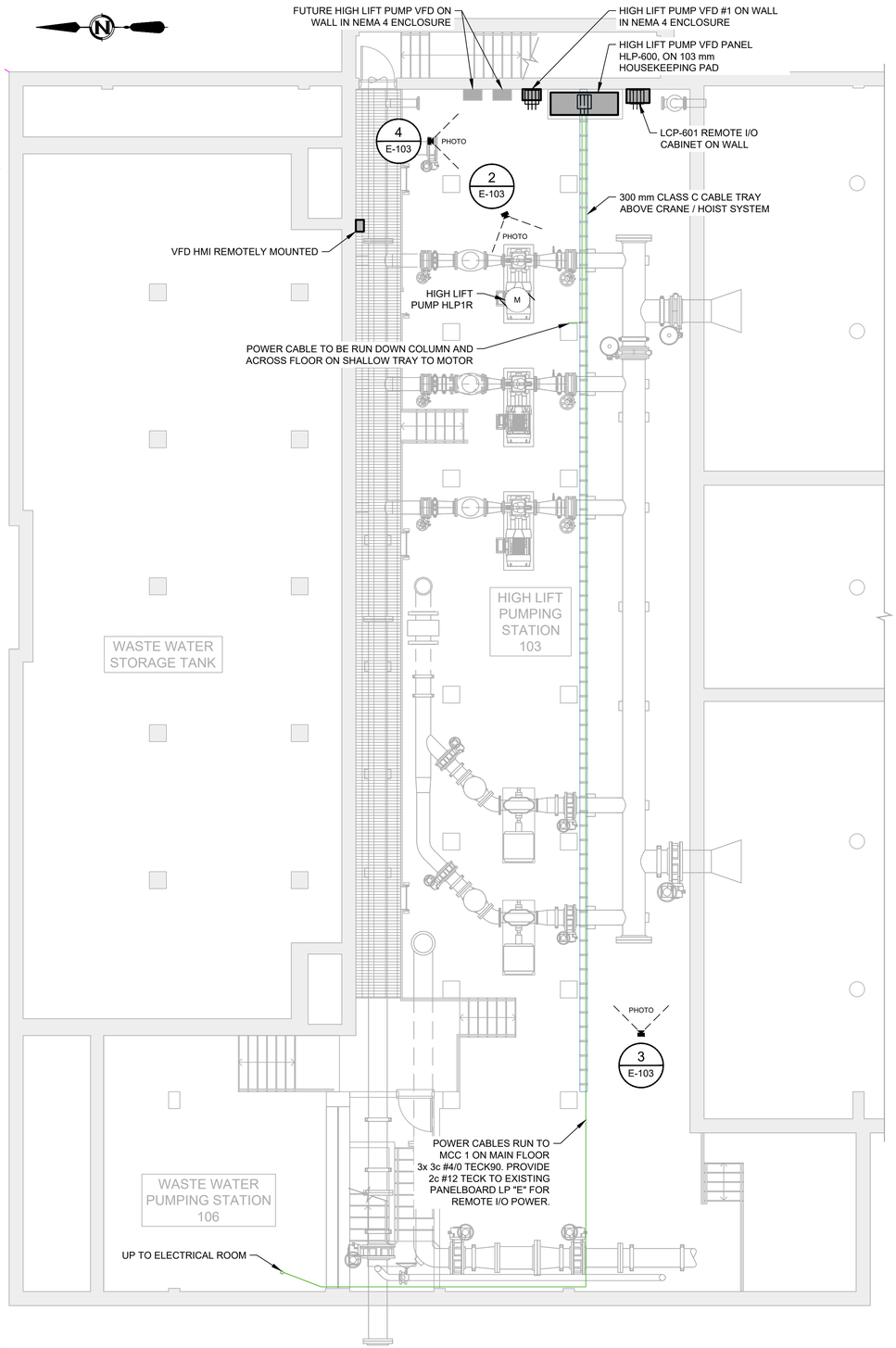
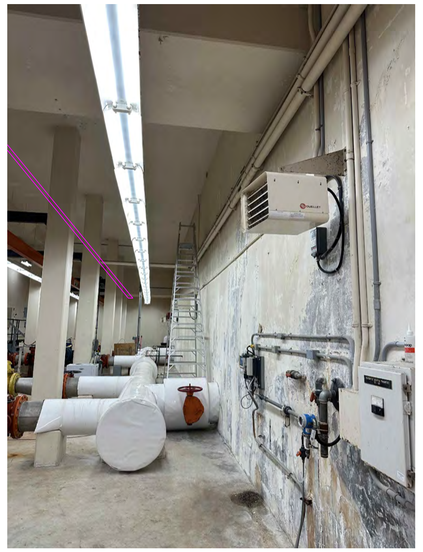


1 E-101 **PLAN** 1:75
EXISTING SUB-BASEMENT FLOOR

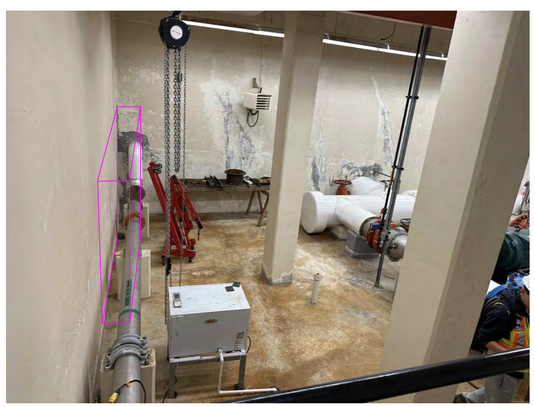
NOTES:

1. CHASE MAY BE USED FOR ROUTING BETWEEN BASEMENT AND SUB-BASEMENT LEVELS.
2. DO NOT DRILL THROUGH PRECAST CONCRETE OF METAL BEAMS USED FOR THE HOIST SYSTEM.
3. VFD HMI REMOTE DISPLAY / INTERFACE IN 4X ENCLOSURE, PROVIDE ETHERNET CABLE TO VFD.
4. CATEGORY 1 AREA, INSTALLATION SHALL BE WEATHERPROOF, CSA ENCLOSURE TYPE 3 OR 4.

2 E-103 **PHOTO** NTS
EXISTING SUB-BASEMENT FLOOR



3 E-103 **PHOTO** NTS
EXISTING SUB-BASEMENT FLOOR



4 E-103 **PHOTO** NTS
EXISTING SUB-BASEMENT FLOOR

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PROVINCE OF ONTARIO
2025-07-23

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CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

ELECTRICAL
EXISTING SUB-BASEMENT FLOOR PLAN & PHOTOS
HIGH LIGHT POWER CABLES AND VFD PANEL

DRAWING	REVISION	SHEET
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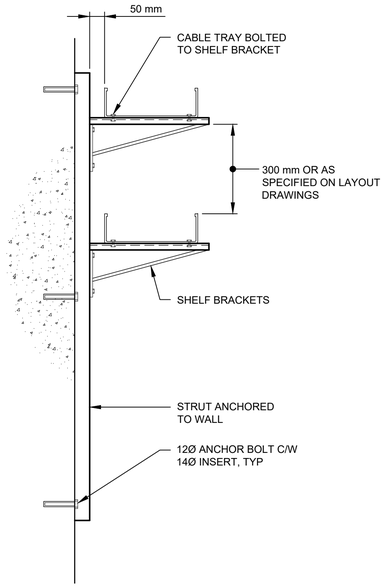
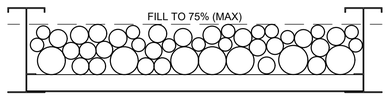
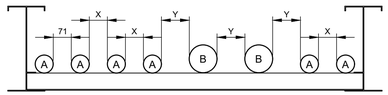


1 E-501 **DETAIL** NTS
CABLE TRAY INSTALLATION



RANDOM STACKED
SEE NOTES 1 & 3

X = DIAMETER OF CABLE 'A'
Y = DIAMETER OF CABLE 'B'

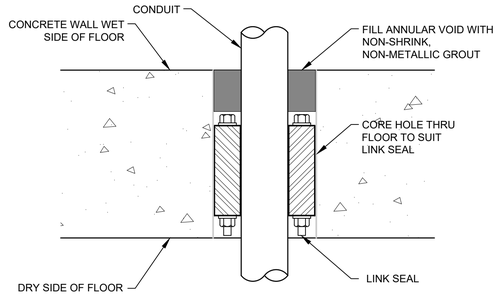


SPACED
SEE NOTE 2

NOTES:

1. RANDOM STACKED - TO ALLOW FOR FUTURE EXPANSION ASSUME MORE THAN 43 POWER CONDUCTORS PER CABLE TRAY. AMPACITY DE-RATED TO 50% FOR CABLES UP TO 1000 V.
2. SPACED CABLES - INSTALL CABLES ONE DIAMETER SEPARATION TO PROVIDE 100% AMPACITY RATING.
3. ASSOCIATED CONTROL TECK 90 CABLES MAY BE INCLUDED WITHOUT AFFECTING RATING.

2 E-501 **DETAIL** NTS
CABLE TRAY FILL REQUIREMENTS



CORED HOLE THROUGH FLOOR

3 E-501 **DETAIL** NTS
CONDUIT FLOOR PENETRATION C/W LINK SEAL

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	E. ENGINEER	D. DRAFTER	ISSUED FOR TENDER

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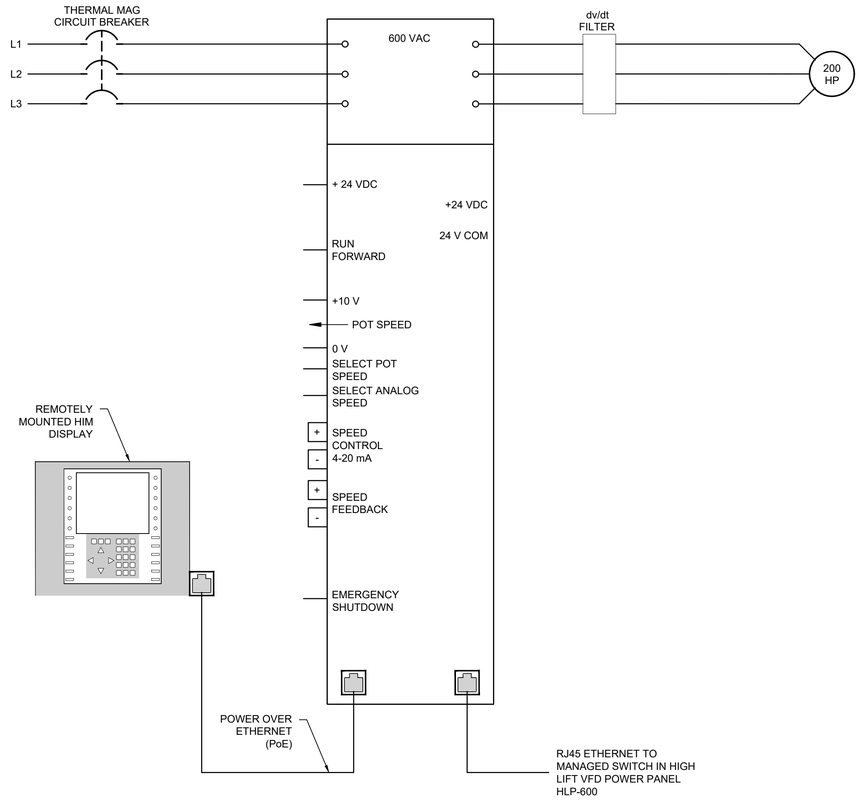
CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

ELECTRICAL
DETAILS

DRAWING	REVISION	SHEET
5895-01-E-501	0	17



1
E-601
SCHEMATIC NTS
HIGH LIFT PUMP VFD

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LICENSED PROFESSIONAL ENGINEER
S. B. FRIEL
100605345
PROVINCE OF ONTARIO
2025-07-23

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	E. ENGINEER	D. DRAFTER	ISSUED FOR TENDER

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

ELECTRICAL
SCHEMATIC
HIGH LIFT PUMP VFD

DRAWING	REVISION	SHEET
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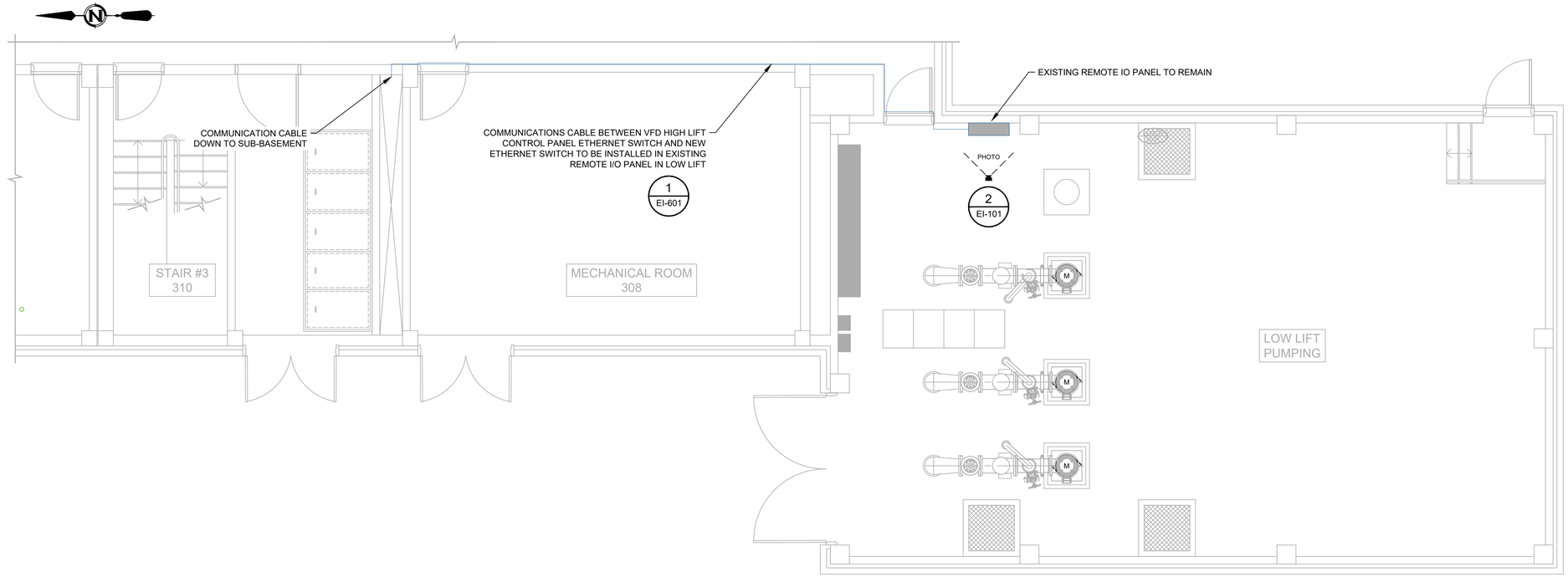
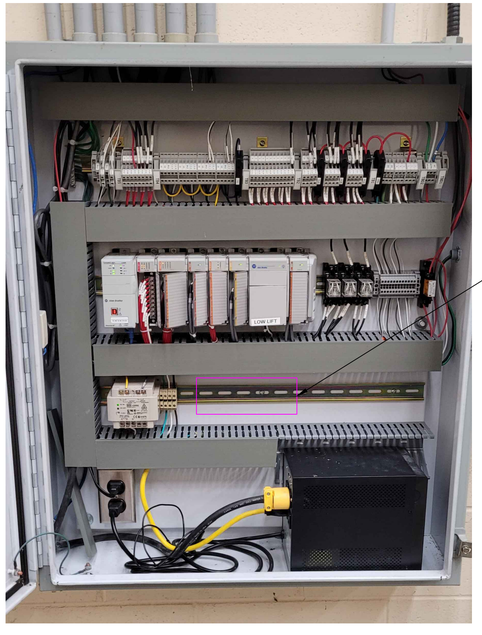


1 EI-101 PLAN 1:75
EXISTING BASEMENT FLOOR



PROVIDE NEW 16 PORT MANAGED NETWORK SWITCH, REDLION/HIRCHMANN OR EQUIVALENT. REDUNDANT 24 VDC POWER. CONNECT EXISTING NETWORK SWITCH AND PROVIDE CABLE FROM SWITCH TO REMOTE I/O PANEL.

2 EI-101 PHOTO NTS
EXISTING INTERIOR REMOTE I/O PANEL - BASEMENT FLOOR

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S. B. FRIEL
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Lake of the Woods KENORA

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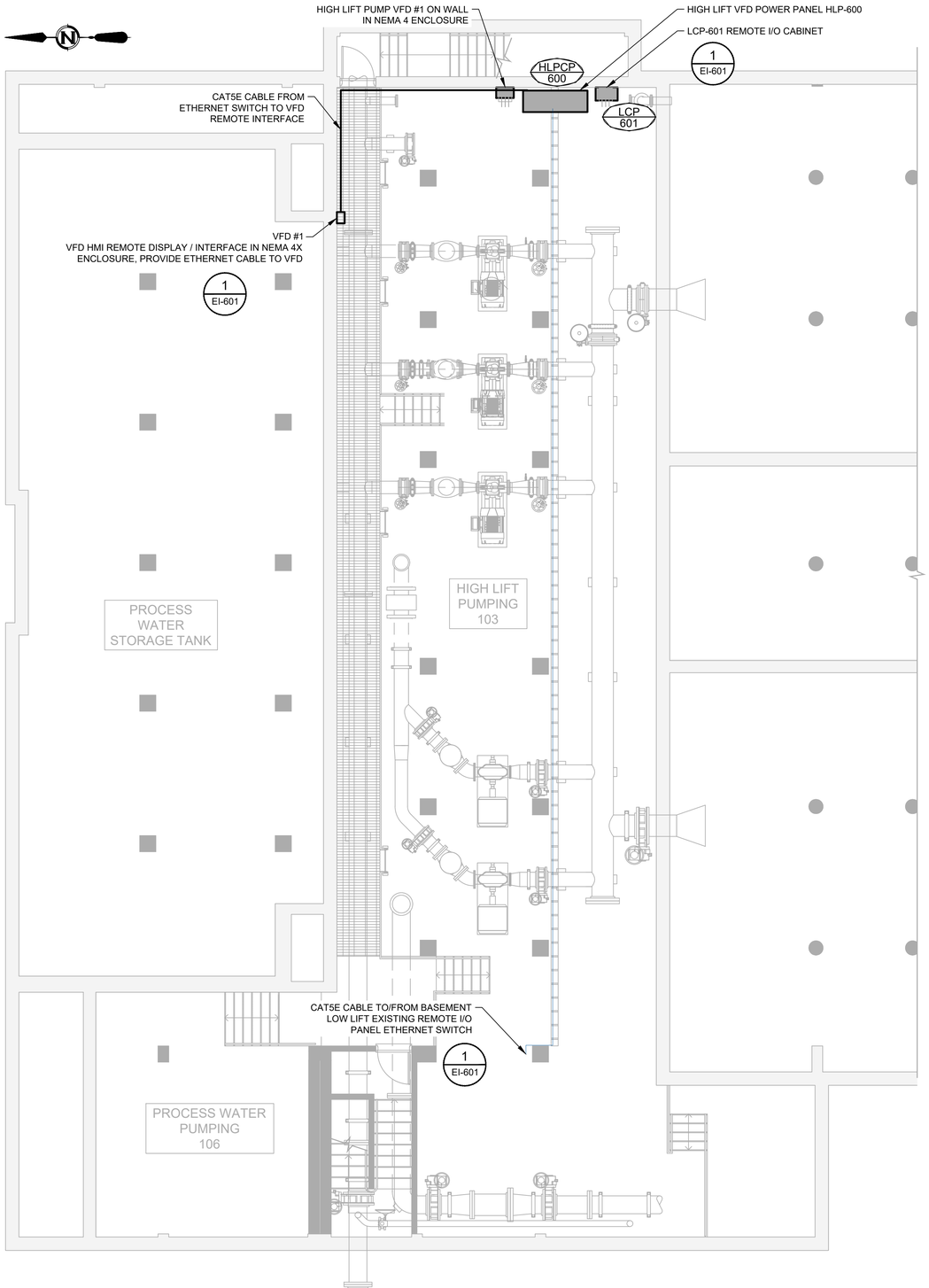
CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

INSTRUMENTATION
EXISTING BASEMENT FLOOR PLAN AND PHOTOS
CONTROL CABLING / DEVICES

DRAWING	REVISION	SHEET
5895-01-EI-101	0	19



1 EI-102 PLAN 1:75

EXISTING SUB-BASEMENT FLOOR

NOTES:

1. CHASE MAY BE USED FOR ROUTING BETWEEN BASEMENT AND SUB-BASEMENT LEVELS.
2. DO NOT DRILL THROUGH PRECAST CONCRETE OF METAL BEAMS USED FOR THE HOIST SYSTEM.
3. VFD HMI REMOTE DISPLAY / INTERFACE IN 4X ENCLOSURE, PROVIDE ETHERNET CABLE TO VFD.

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SCALE: AS SHOWN

INSTRUMENTATION
EXISTING SUB-BASEMENT FLOOR PLAN
CONTROL CABLING / DEVICES

DRAWING	REVISION	SHEET
5895-01-EI-102	0	20

IF NOT 50 mm ADJUST SCALES
50 mm

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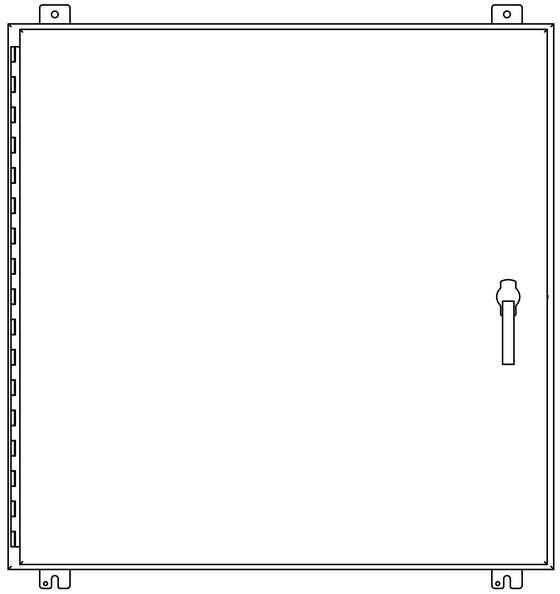
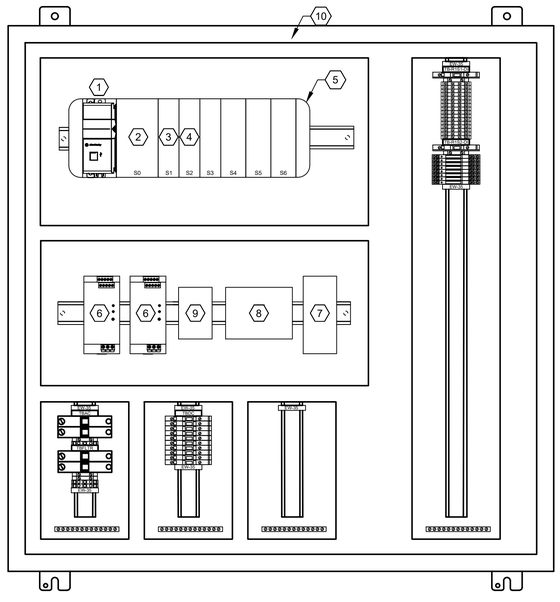


1 / EI-501 DETAIL NTS

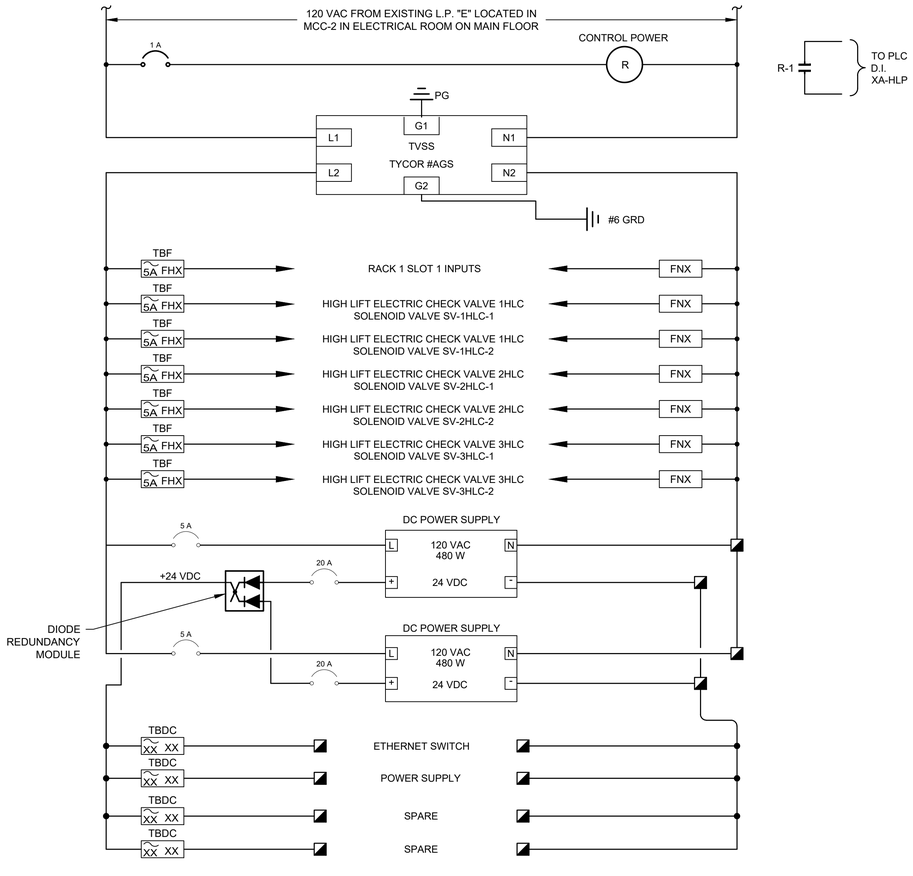
HIGH LIFT REMOTE I/O PANEL
LCP-601 EXTERIOR

CONTROL PANEL BILL OF MATERIALS				
ITEM NO.	QUANTITY	MANUFACTURER	DESCRIPTION	CATALOGUE NO.
1	1	ALLEN BRADLEY	COMPACTLOGIX ETHERNET COMMUNICATION MODULE	1769-AENTR
2	1	ALLEN BRADLEY	COMPACTLOGIX POWER SUPPLY	1769-PA4
3	1	ALLEN BRADLEY	COMPACTLOGIX PLC 24VDC 16PT DI MODULE	1769-IA16
4	1	ALLEN BRADLEY	COMPACTLOGIX PLC 24VDC 8PT RELAY MODULE	1769-OA8
5	AS REQUIRED	ALLEN BRADLEY	COMPACTLOGIX PLC END CAP	1769-ECR
6	2	PHOENIX	PHOENIX CONTACT QUINT-PS-1AC/24VDC/5	2866750
7	1	ALLEN BRADLEY	5 PORT UNMANAGED ETHERNET SWITCH	SEE SPECS
8	1	PHOENIX	120VAC, 10 A EMC POWER FILTER SOURCE PROTECTOR	2920670
9	1	PHOENIX	QUINT PS DIODE MODULE, 24VDC	2320157
10	1	HOFFMANN	NEMA 4, 304 STAINLESS STEEL WALLMOUNT ENCLOSURE	SIZE AS REQUIRED
-	AS REQUIRED	WEIDMULLER	SINGLE POLE, 10A BRANCH RATED CIRCUIT BREAKER	9926251010
-	AS REQUIRED	WEIDMULLER	SINGLE POLE, 8A BRANCH RATED CIRCUIT BREAKER	9926251008
-	AS REQUIRED	WEIDMULLER	SINGLE POLE, 2A BRANCH RATED CIRCUIT BREAKER	9926251002
-	AS REQUIRED	WEIDMULLER	WIEDMULLER TERMINAL	WDU 2.5
-	AS REQUIRED	WEIDMULLER	WEIDMULLER FUSED TERMINAL WITH INDICATOR	WSI 6LD SERIES
-	AS REQUIRED	WEIDMULLER	WEIDMULLER GROUND TERMINAL	WPE 2.5
-	AS REQUIRED	WEIDMULLER	WEIDMULLER DISCONNECT TERMINAL	WTR 2.5
-	AS REQUIRED	WEIDMULLER	WEIDMULLER CONTACT PLC INTERFACE RELAYS	TRS 25 VDC 1CO AU
-	AS REQUIRED	OMRON	OMRON RELAY WITH INDICATOR	LY2N-D2
-	1	SCHNEIDER	EXTERIOR DOOR LIMIT SWITCH	XCKP2145N12



2 / EI-501 DIAGRAM NTS

POWER DISTRIBUTION
LCP-601 INTERIOR



3 / EI-501 DIAGRAM NTS

POWER DISTRIBUTION
LCP-601

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Platinum member

LICENSED PROFESSIONAL ENGINEER
S. B. FRIEL
100605345
PROVINCE OF ONTARIO
2025-07-23

REV	DATE	DESIGN	DRAWN	DESCRIPTION
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Lake of the Woods KENORA

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAMS AND DETAIL
HIGH LIFT REMOTE IO PANEL

DRAWING	REVISION	SHEET
5895-01-EI-501	0	21

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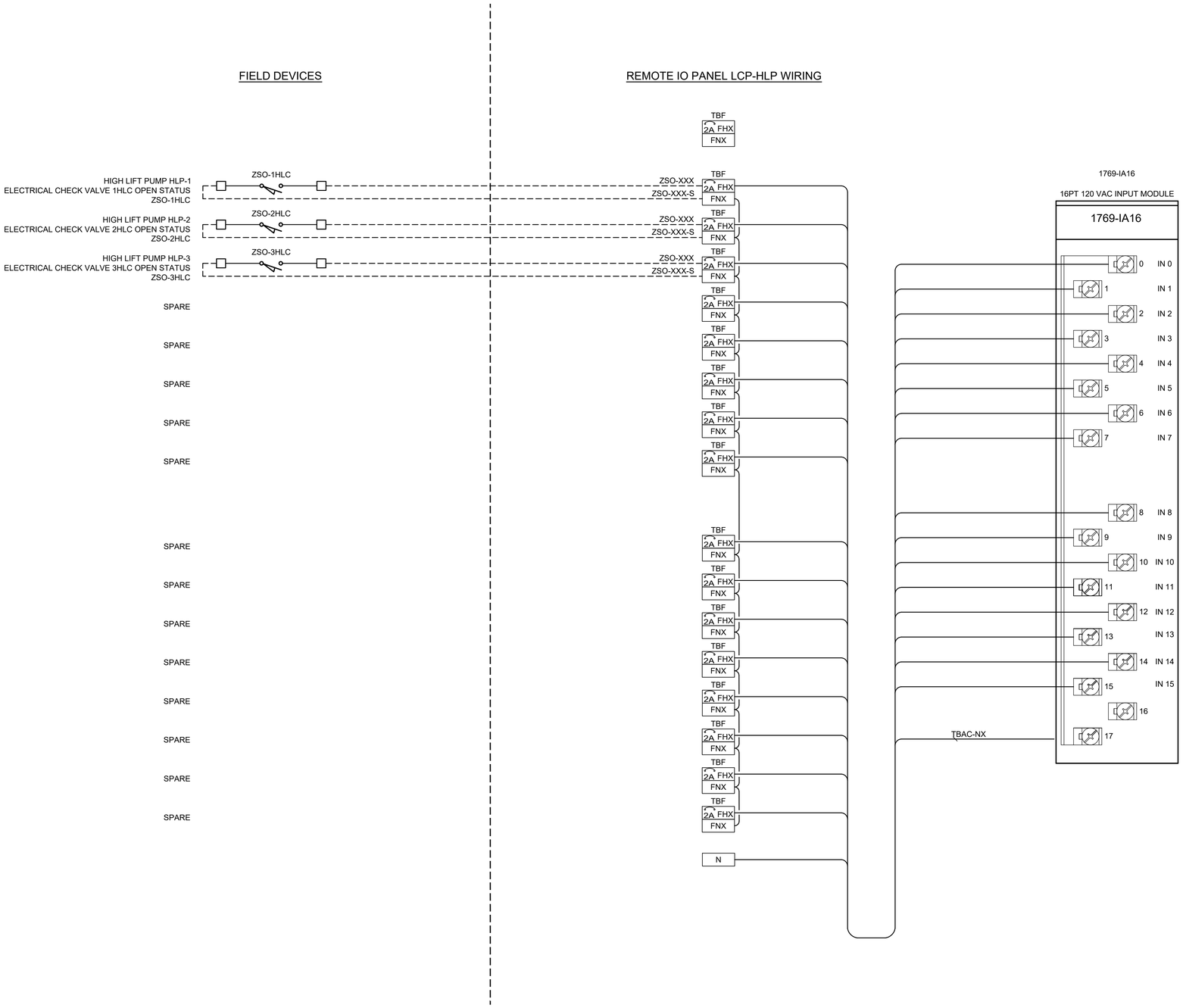
IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 / EI-502 DIAGRAM NTS
RACK 1, SLOT 1 WIRING

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REV	DATE	DESIGN	DRAWN	DESCRIPTION
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Lake of the Woods KENORA

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CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 1, SLOT 1 WIRING

DRAWING	REVISION	SHEET
5895-01-EI-502	0	22

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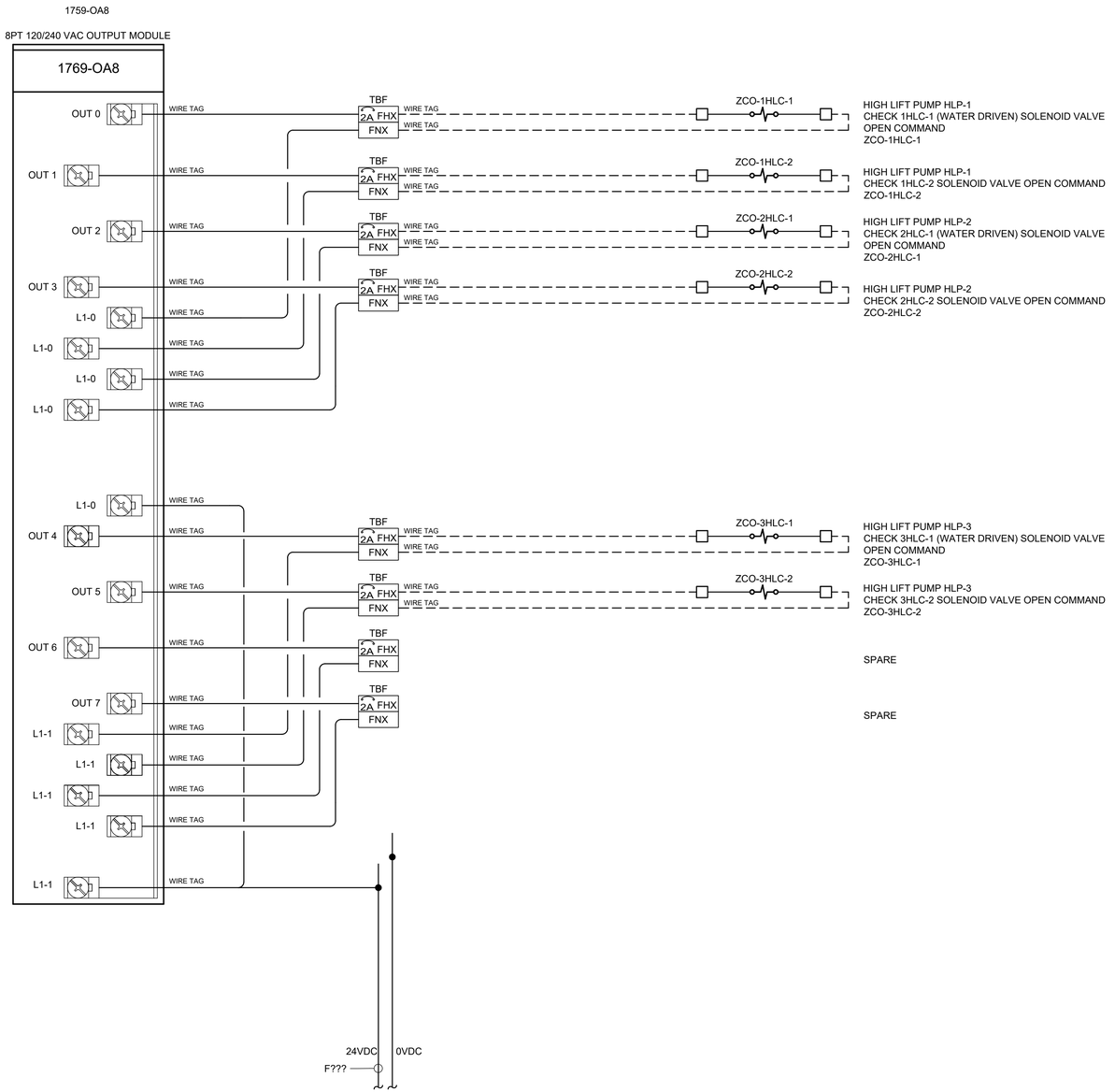

1 EI-503 DIAGRAM NTS
RACK 1, SLOT 2 WIRING

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
S. B. FRIEL
100605345
PROVINCE OF ONTARIO
2025-07-23

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	E. ENGINEER	D. DRAFTER	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 1, SLOT 2 WIRING

DRAWING	REVISION	SHEET
5895-01-EI-503	0	23

IF NOT 50 mm ADJUST SCALES
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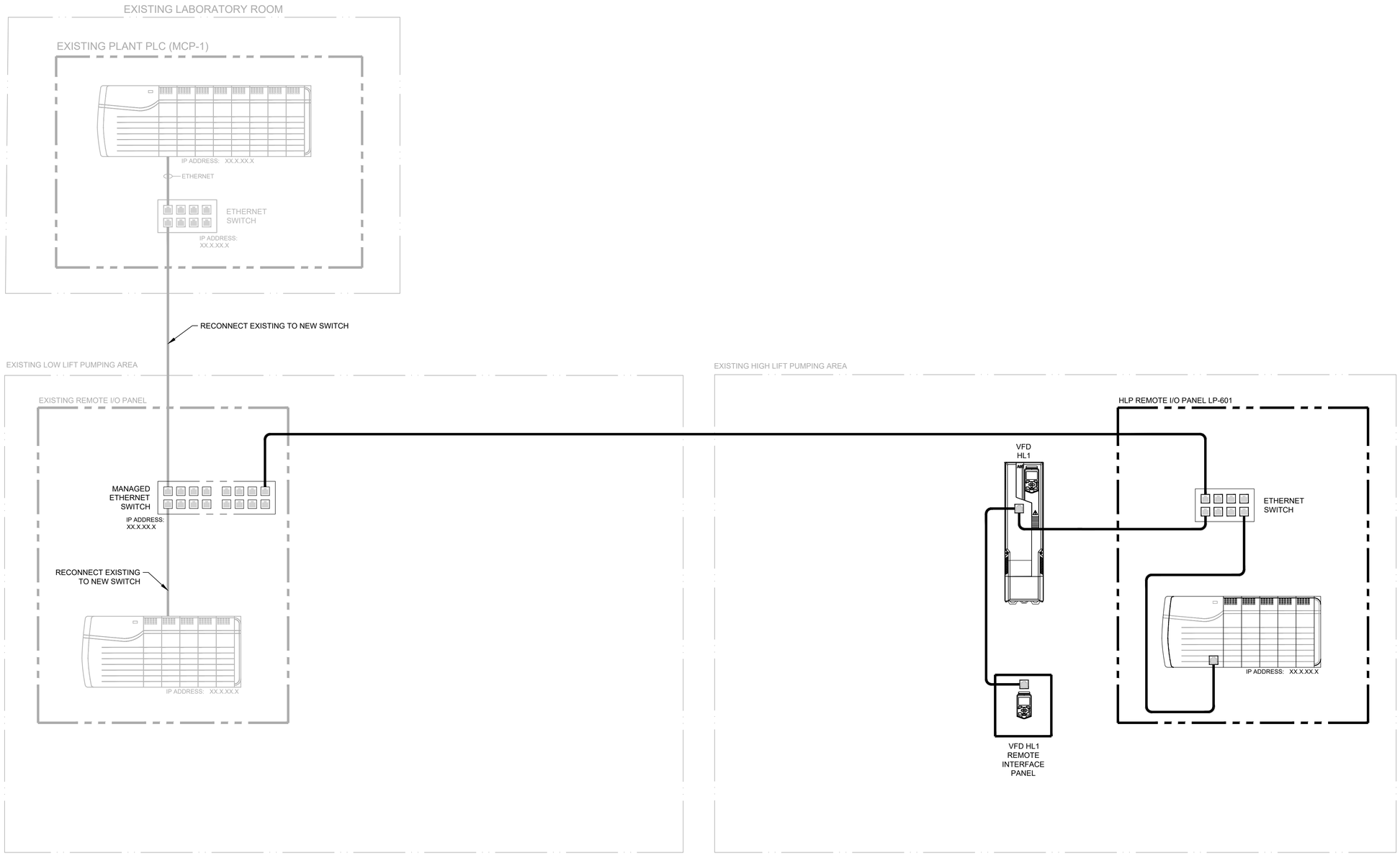
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 EI-601 DIAGRAM NTS
NETWORK CONTROL COMMUNICATIONS

Associated Engineering

CANADA'S BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
S. B. FRIEL
100605345
PROVINCE OF ONTARIO
2025-07-23

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025JUL14	S. FRIEL	A. JAEB	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

CITY OF KENORA WTP
2025 PUMP REPLACEMENT

2025-5895-01

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
NETWORK CONTROL COMMUNICATIONS

DRAWING	REVISION	SHEET
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Phase 1 WTP Pump Replacement and WWTP Electrical Upgrades

Part 2: Wastewater Treatment Plant Electrical Upgrades

Appendix “B-2” – Specifications

Appendix "C-2” - Drawings

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

Lake of the Woods KENORA

CONTRACT DOCUMENTS

City of Kenora

City of Kenora Wastewater Treatment Plant
Building 200 and 400 Electrical Upgrades

June 2025

CONTRACT SPECIFICATIONS

City of Kenora Wastewater Treatment Plant Building 200 and 400 Electrical Upgrades

Mechanical Engineer

Electrical Engineer

Structural Engineer

Prepared by Associated Engineering (Ont.) Ltd.

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DOCUMENTS/SECTIONS **PAGES**

END OF SECTION

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1	5884-00-G-001	0	COVER SHEET	
2	5884-00-C-101	0	EXISTING SITE PLAN	WWTP
3	5884-00-S-101	0	PLAN AND SECTION	AEROBIC DIGESTER BUILDING 400
4	5884-00-S-102	0	EXISTING SECOND FLOOR PLAN	SCREW PUMP BUILDING 200
5	5884-00-S-201	0	EXISTING SOUTH ELEVATION	SCREW PUMP BUILDING 200
6	5884-00-M-001	0	LEGEND	
7	5884-00-M-101	0	EXISTING UPPER AND LOWER LEVEL PLANS	VENTILATION - SCREW PUMP BUILDING 200
8	5884-00-M-102	0	EXISTING BASEMENT AND GROUND FLOOR PLANS	VENTILATION - DIGESTER CONTROL BUILDING 400
9	5884-00-M-601	0	DETAIL	
10	5884-00-E-001	0	LEGEND	
11	5884-00-ED-101	0	EXISTING FLOOR PLANS - DEMOLITION	SCREW PUMP BUILDING AND DIGESTER BUILDING
12	5884-00-ED-501	0	EXISTING PHOTOS - DEMOLITION	SCREW PUMP BUILDING AND DIGESTER BUILDING
13	5884-00-E-101	0	EXISTING SITE PLAN	POWER
14	5884-00-E-102	0	EXISTING UPPER AND LOWER LEVEL PLANS	POWER - SCREW PUMP BUILDING 200
15	5884-00-E-103	0	EXISTING BASEMENT AND MAIN FLOOR PLAN	POWER - DIGESTER CONTROL BULDING 400
16	5884-00-E-501	0	DETAILS	
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18	5885-00-E-601	0	SCHEMATICS	STARTER CONTROL
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23	5884-00-EI-601	0	DIAGRAM	PLC POWER DISTRIBUTION
24	5884-00-EI-602	0	DIAGRAM	RACK 0 SLOT 2 DIGITAL INPUT MODULE
25	5884-00-EI-603	0	DIAGRAM	RACK 0 SLOT 3 DIGITAL INPUT MODULE
26	5884-00-EI-604	0	DIAGRAM	RACK 0 SLOT 4 DIGITAL INPUT MODULE
27	5884-00-EI-605	0	DIAGRAM	RACK 0 SLOT 5 DIGITAL INPUT MODULE
28	5884-00-EI-606	0	DIAGRAM	RACK 0 SLOT 6 DIGITAL OUTPUT MODULE
29	5884-00-EI-607	0	DIAGRAM	RACK 0 SLOT 7 DIGITAL OUTPUT MODULE
30	5884-00-EI-608	0	DIAGRAM	RACK 0 SLOT 8 ANALOG INPUT MODULE
31	5884-00-EI-609	0	DIAGRAM	RACK 0 SLOT 9 ANALOG INPUT MODULE
32	5884-00-EI-610	0	DIAGRAM	RACK 0 SLOT 10 ANALOG OUTPUT MODULE

END OF DOCUMENT

1.1 THE WORK

.1 Description or title of the Work:

.1 City of Kenora Wastewater Treatment Plant Building 200 and 400 Electrical Upgrades.

.2 Located at:

.1 18 Sewage Treatment Plant Road, City of Kenora Wastewater Treatment Plant

.3 Owner:

.1 City of Kenora

1.2 CONTRACT AGREEMENT

.1 The Agreement between the City of Kenora, and the Contractor shall be the Standard Construction Document CCDC 2-2020, Stipulated Price Contract as approved by the Canadian Construction Documents Committee.

.2 Provide all necessary materials, labour, supervision and equipment, and perform all work and fulfill everything as set forth in strict accordance with the Contract Documents and Addenda.

END OF DOCUMENT

MODIFICATIONS TO GENERAL CONDITIONS

Supplementary Conditions to CCDC 2 – 2020 Stipulated Price Contract. The Contract is hereby revised as follows:

ARTICLE A-5 PAYMENT

Add 5.1.4 as follows:

.4 hold back 10%, or other percentage as required by the Lien Act, of any amounts net of value-added taxes due to the Contractor, if required by the Lien Act, such amounts will include amounts due for payment for Work performed after Substantial Performance of the Work"

DEFINITIONS

Definition "Owner", add the following:

"Owner shall mean **The City of Kenora**"

Add Definition

"Total Performance of the Work" means the Work, with the exception of Warranty Work, has been fully completed, including rectification of all known Deficiencies, and the Engineer has issued a certificate verifying that, in the opinion of the Engineer, Total Performance of the Work has been achieved.

GC 2.1 AUTHORITY OF THE CONSULTANT

Delete 2.1.1 and 2.1.2 and replace as follows:

2.1.1 The Engineer shall have authority to act on behalf of the Owner only to the extent provided for in this Contract or as the Owner may authorize, from time to time, but only to the extent that such authorization is communicated to the Contractor by Notice from the Owner.

2.1.2 The duties, responsibilities, and limitations of authority of the Engineer shall only be modified or extended by a Notice issued by the Owner to the Contractor.

GC 2.3 REVIEW AND INSPECTION OF THE WORK

Delete 2.3.2 and replace as follows:

2.3.2 If any portion of the Work is designated for tests, inspections or approvals in the Contract Documents, or by the Engineer, or by Law, the Contractor shall give the Engineer Notice of not less than 5 Business Days of when the Work will be ready for review and inspection. The Contractor shall arrange for, and shall give the Engineer reasonable Notice of, the date and time of inspections by all Governmental Authorities.

GC 2.4 DEFECTIVE WORK

Add 2.4.4 to 2.4.8 as follows:

1.4.4 At all times during the performance of the Work, the Contractor shall promptly remedy, correct and rectify any Deficiencies, whether or not the Deficiencies have been incorporated in the Work, and whether or not the Deficiencies are the result of poor workmanship, use of defective Materials, or vandalism, theft or damage through carelessness, negligence, inadequate security or

protection or other act or omission of the Contractor or any Person for whom the Contractor is responsible at Law.

1.4.5 The Contractor shall remedy, correct and rectify, as required to ensure the timely performance of the Work in accordance with the Construction Schedule, any and all:

(a) Deficiencies in a manner acceptable to the Engineer and the Owner; and

(b) Work, or other work, that is destroyed or damaged as a result of the Deficiencies or the remedying or correction thereof.

1.4.6 The Engineer may withhold from amounts due to the Contractor amounts on account of Deficiencies in accordance with GC 5.8 - WITHHOLDING OF PAYMENT AND SET OFF.

1.4.7 The Contractor is obligated to remedy, correct and rectify Deficiencies at its own cost and expense. The Contractor is not entitled to any payment under the Contract for any deficient Work or Materials that are incorporated into any Deficiency or that are otherwise in breach of the Contractor's obligations under this Contract. If the Owner or Engineer incur additional costs and expenses as a result of the Deficiencies including the Contractor's repairs or corrections of Deficiencies, the Contractor is liable to the Owner for such amounts and they may be withheld pursuant to GC 5.8 - WITHHOLDING OF PAYMENT AND SET OFF.

1.4.8 In the event that the Contractor does not remedy, correct or rectify the Deficiencies as required herein, the Owner may, upon expiry of 10 Business Days after giving Notice to the Contractor, take such steps as may be necessary to remedy, correct or rectify the Deficiencies in the Work or other work which is damaged or destroyed as a result of the Deficiencies or the remedying or correction thereof. In such event, the Contractor shall promptly pay the Owner for costs incurred by the Owner for remedying, correction or rectification of those Deficiencies, including both the Work or other work, if any, destroyed or damaged, or any alterations necessitated by the Contractor failing to remedy, correct or rectify the Deficiencies and any claims incurred by the Owner in so doing may be set-off against any monies due from the Owner to the Contractor.

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

Add 5.4.7 to 5.4.12 as follows:

5.4.7 When the Contractor considers that it has achieved Substantial Performance of the Work, the Contractor shall prepare and submit to the Engineer:

(a) a written application from the Contractor for a Certificate of Substantial Performance; and

(b) the Contractor's application for a Certificate of Substantial Performance shall constitute a waiver and release by the Contractor of any and all claims arising out of or relating to the Contract to the date of Substantial Performance. This waiver shall include without limitation those claims that might arise from the negligence or breach of contract by the Owner, the Engineer, and their respective employees, agents, officers, directors, and consultants, but does not include any claims made by the Contractor in writing prior to such application in accordance with the provisions of the Contract Documents and delivered to the Engineer prior to the date of Substantial Performance and still unsettled.

5.4.8 Failure to include an item on the comprehensive list of items described in paragraph 5.4.1 in GC 5.4 does not alter the responsibility of the Contractor to complete the Work or remedy, correct or rectify any Deficiencies.

5.4.9 If the Engineer determines that Substantial Performance of the Work has not been achieved, the Owner may deduct the cost of the inspection and assessment by the Engineer from payments otherwise due to the Contractor.

5.4.10 The Contractor may, after performing the required Work, re-apply for the Certificate of Substantial Performance, and the provisions of GC 5.4 shall apply to the re-application.

5.4.11 The Engineer shall include the date of Substantial Performance of the Work in the Certificate of Substantial Performance.

5.4.12 The Contractor shall promptly post a copy of the Certificate of Substantial Performance at a prominent and visible location at the Project Site.

GC 6.2 CHANGE ORDER

Add 6.2.3 to 6.2.5 as follows:

6.2.3 Costs for increase in the Contract Price, unless otherwise agreed, shall be marked up as follows:

.1
.2 Materials supplied by the Contractor shall be paid for at Supplier's or subtrade's invoice price plus an additional payment of ten percent (10%) of cost to cover handling and indirect overhead costs.
.3 For subcontract Work, the allowance to the Contractor for profit, superintendence, and all other expenses shall be ten percent (10%) of the Subcontractor's invoice for such Work performed. No additional mark-up shall be allowed for subcontractors to subcontractors or beyond.
.4 Credits for decreases in the Contract Price may not be marked up.

6.2.4 The contractor must submit all details of quantities, prices and fees as outlined above, together with substantiating documentation.

6.2.5 A Change Order shall represent complete payment to the Contractor including for all impacts, related costs and expenses, including, without limitation time, labour, Materials, equipment, mobilization, Subcontractors, overhead, profit, insurance, bonding, and tools. The Contractor shall not be entitled to any additional change in Contract Time, Contract Price or any compensation for delay or other Claims arising from a duly executed Change Order.

GC 6.3 CHANGE DIRECTIVE

Delete 6.3.6.3 and replace as follows:

6.3.6.3 The Contractor's fee shall be as specified in paragraph 6.2.3 of GC 6.2.

GC 6.5 DELAYS
Add 6.5.6 to 6.5.9 as follows:

6.5.6 The Contractor acknowledges that if the Contractor fails to complete the Work within the Contract Time or fails to meet a specified Milestone Date for any part of the Work, the Owner will incur additional costs and expenses including additional administrative and overhead costs and will be required to pay additional compensation to the Engineer (collectively "Additional Expenses"). The Contractor agrees that in the event the Contractor fails to complete the Work within the Contract Time or fails to meet a specified Milestone Date for any part of the Work, the Owner may deduct from any monies owing to the Contractor for the Work, as a genuine pre-estimate of the Owner's Additional Expenses, the amount specified under 6.5.9 of GC 6.5 for each Working Day the Work or any portion of the Work remains incomplete after the applicable Contract Time or Milestone Date. The Owner is not required to deduct such amounts from a current Payment Certificate but may instead deduct such amounts from a subsequent Payment Certificate or seek such amounts from the Contractor as a Claim.

6.5.7 The rights set out in paragraph 6.5.6 of GC 6.5 are in addition to any other rights the Owner may have and are in no way exclusive. The Contractor acknowledges that regardless of any amount specified in the Supplementary Conditions, the Owner may seek to recover from the Contractor its actual losses and damages suffered or incurred in respect of Additional Expenses, in addition to any other claim the Owner may have at Law.

6.5.8 No bonus will be allowed by the Owner for completion of the Work in less than the Contract Time.

6.5.9 The pre-estimate of the Owner's additional costs pursuant to paragraph 6.5.6 of GC 6.5 shall be $2,500 per Working Day.

GC 9.4 CONSTRUCTION SAFETY

Add 9.4.6 as follows:

9.4.6 The Contractor shall at all times comply with the provisions of all Law related to safety including the OH&S Legislation. The Contractor shall at all times ensure that all subcontractors at the Site shall comply with the requirements of all Law related to safety including the OH&S Legislation. The Contractor shall bring to the attention of all subcontractors the provisions of the OH&S Legislation.

GC 10.1 TAXES AND DUTIES

Delete paragraphs 10.1.1 to 10.1.2 and replace with the following:

10.1.1 The Contract Price includes all customs duties and taxes, except Goods and Services Tax (GST) or Harmonized Sales Tax (HST) or provincial sales taxes (PST), in effect at the time of the execution of this Contract.

10.1.2 The Contractor shall be responsible to pay all taxes.

10.1.3 The amount of GST, HST or PST payable by the Owner on goods and services provided under this Contract is in addition to the Contract Price and is to be shown on a separate line on Payment Certificates.

10.1.4 If the Owner is exempt from GST, HST or PST, a Certificate of Exemption will be issued to the Contractor following issuance of the Notice of Award.

10.1.5 The Contract Price shall include any tax rebates which may be applicable under current legislation. Upon request by the Contractor, the Owner shall provide certificates, in support of the Contractor's rebate submission to a Governmental Authority. The Owner shall not be liable to compensate the Contractor for any tax rebates that are denied by Governmental Authorities.

10.1.6 In the event that new or additional duties or taxes in respect of the Work are applicable or required by the Law after this Contract is executed, the Contract Price shall be adjusted to include such new or additional taxes and duties, if applicable.

GC 12.3 WARRANTY

Delete paragraphs 12.3.1 to 12.3.6 and replace with the following:

12.3.1 The Contractor warrants that the Work, including all workmanship, labour, Materials and equipment supplied by the Contractor, either directly or indirectly, and incorporated into the Work, shall comply in all respects with this Contract and shall be free from Deficiencies.

12.3.2 Subject to paragraphs 12.3.3 and 12.3.4 of GC 12.3, the Warranty Period with regard to the Work begins on the date of Total Performance and continues for a period of one year, except where a longer period is specified in the Contract Documents, then that period specified in the Contract Documents shall apply from the date specified in the Contract Documents or, if no date is specified, from the date of Total Performance of the Work.

12.3.3 Where Warranty Work is performed, regardless of the initial Warranty Period, the Warranty Period shall recommence for that Warranty Work for the same period as initially contemplated commencing on the date of completion of the Warranty Work.

12.3.4 The Contractor shall perform the Warranty Work, at the Contractor’s expense, for all Deficiencies which appear during the Warranty Period for which the Contractor is provided Notice by the Owner or the Engineer no later than 30 Business Days after the end of the Warranty Period. The cost and expense of the Warranty Work for which the Contractor is responsible includes all costs and expenses incurred by the Owner and the Engineer in facilitating, administrating, or approving the Warranty Work.

12.3.5 The Contractor shall perform the Warranty Work promptly after Notice, provided that all Warranty Work carried out by the Contractor shall be performed during periods of time acceptable to the Owner.

12.3.6 In the event that the Contractor does not take steps to perform Warranty Work as required within a time period directed by or agreed upon by the Owner, the Owner may, upon expiry of 14 Business Days after giving Notice to the Contractor, take such steps as may be necessary to perform the Warranty Work. In such event, the Contractor shall promptly pay the Owner for costs incurred by the Owner the performance of the Warranty Work, including the cost to remedy any Deficiencies and to repair any other Work, if any, destroyed or damaged, or any alterations necessitated by the Contractor failing perform the Warranty Work.

12.3.7 The Contractor shall ensure that any Warranty Work which is of an emergency nature, as reasonably determined by the Owner, is performed immediately upon receipt of Notice from the Owner or the Engineer.

GC 13.1 INDEMNIFICATION

Delete paragraphs 13.1.1 to 13.1.5 and replace with the following:

13.1.1 The Contractor shall at all times and without limitation, be fully liable for, and shall indemnify and save harmless the Owner and its Personnel, including the Engineer, from and against all liabilities, losses, injuries, costs, damages, legal fees and disbursements on a solicitor and own client basis, disbursements, fines, penalties, expenses, all manner of actions, causes of action, claims, demands and proceedings, all of whatever nature and kind, which any of the Owner and its Personnel, including the Engineer, may sustain, pay or incur or which may be brought or made against all or any of them, and whether or not incurred, in connection with any action or other proceedings or claims or demands made by third parties, relating to, or resulting from or arising out of all or any of the following:

(a) the misconduct, negligent action or negligent failure to act, as the case may be, of the Contractor or any of those Persons for whom the Contractor is responsible at Law (including, without limitation, any of its Personnel or Subcontractors);

(b) the costs of repairs, clean-up or restoration paid by the Owner and any fines levied against the Owner or the Contractor;

(c) any breach, violation or non-performance of any representation, warranty, obligation, covenant, condition or agreement in this Contract set forth and contained on the part of the Contractor to be fulfilled, kept, observed or performed, as the case may be;

(d) any damages to third parties caused by, resulting at any time from, arising out of or in consequence of the misconduct, negligent action or failure to act of the Contractor or any of those Persons for whom the Contractor is responsible at Law (including, without limitation, any of its Personnel or Subcontractors);

(e) any damages, costs, fines, expenses and penalties that the Owner is required to pay on account of the Contractor performing the Work in breach of any Workers Compensation Legislation order or regulation; or

(f) any damages, costs, fines, expenses and penalties arising out of or as a result of the Contractor's failure, or the failure of any Person for whom the Contractor is responsible at Law, to comply with the requirements of GC 9.2 TOXIC OR HAZARDOUS SUBSTANCES.

13.1.2 The provisions in GC 13.1 are in addition to and shall not prejudice any other rights of the Owner at Law or in equity.

13.1.3 The Owner shall indemnify and hold harmless the Contractor and its Personnel from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the Contractor's performance of the Contract which are attributable to a lack of or defect in title to the Project Site.

13.1.4 If the Owner performs work at the Project Site at the same time as the Contractor is performing the Work, then the Owner shall indemnify and hold harmless the Contractor and its Personnel from and against claims, demands, losses, costs, damages, actions, suits or proceedings by third

parties that arise out of or are attributable to, any act or omission or alleged act or omission of the Owner and its Personnel in the performance of that work.

13.1.5 If it becomes necessary for the Owner or its Personnel, including the Engineer, to take or to become involved in any action, including but not limited to legal proceedings, to enforce any term of this Contract, the Contractor shall be liable for and will pay to the Owner and its Personnel, including the Engineer, all costs, including but not limited to legal fees and disbursements on a solicitor and own client basis, incurred by the Owner and its Personnel, including the Engineer, in relation to the action to enforce any term of this Contract.

ADDITIONAL GENERAL CONDITIONS

The following General Conditions are hereby added:

GC 5.8 WITHHOLDING OF PAYMENT AND SET OFF

5.8.1 Subject to paragraph 5.8.2 of GC 5.8, if for any reason there are any Deficiencies, including those that require Warranty Work, any portion of the Work that is not performed or there is any Claim by a third party made against the Owner arising from the Work, the Owner may withhold from payment to the Contractor such amounts as the Engineer determines are sufficient and reasonable to cover the cost of rectification, completion or resolution, until the Deficiencies are rectified, the Work is completed or such Claim is resolved.

5.8.2 The cost of rectifying Deficiencies or completing Work not performed shall be estimated by the Engineer and a value equivalent to twice that amount shall be withheld from any payment. Such holdback shall include any costs or expenses that the Engineer believes may be reasonably incurred by the Owner or Engineer as a result of the additional Work required to rectify the Deficiencies or to complete the Work not performed. Subject to any other right the Owner may have, the holdback amount shall be paid to the Contractor upon rectification of the Deficiencies or completion of the Work not performed, less:

(a) any actual additional costs or expenses incurred by the Owner or Engineer related to the Deficiencies and their rectification, after proper rectification of all the Deficiencies and completion of all Work; and

(b) any amount withheld pursuant to paragraph 5.8.1 of GC 5.8 for any Claim by third parties made against the Owner.

5.8.3 In preparing the estimate referred to in paragraph 5.8.2 of GC 5.8, the Engineer shall not be bound by the Contractor's unit prices and shall estimate the cost of rectifying Deficiencies or completing Work using their sole judgement of the influence of prevailing circumstances.

5.8.4 Notwithstanding any other provision of this Contract, the Owner shall be entitled to withhold and set-off against any monies otherwise due and payable to the Contractor under this Contract, any sums which the Owner is permitted to withhold either pursuant to this Contract or to any other agreement between the Owner and the Contractor, howsoever arising.

5.8.5 The Owner shall not pay interest on any amounts withheld from the Contractor under GC 5.8.

END OF DOCUMENT

Part 1 General

1.1 ORDER OF PRECEDENCE

.1 In the event of a conflict between the drawings and specifications, the contractor will endeavour to obtain clarification from the Engineer in an appropriate fashion prior to submitting their bid.

1.2 SUMMARY OF WORK

.1 The Contractor is responsible for reviewing all specifications and drawings together to determine the full extent of the contract scope and complexity. Work to be carried out under the Contract in general includes, but is not limited to the following:

- .1 Repair existing screw pump shaft maintenance hole gaskets.
- .2 Install airtight gaskets onto existing hatches connecting the ground and second floors in the Screw Pump Building.
- .3 Installation of new exhaust fans on the screw pump channels.
- .4 Core new holes and install new exhaust fans onto the existing Screw Pump channel walls.
- .5 Demolish the starter and control from the MCC and supply and install 2 new Panels with Softstarters for Screw Pumps.
- .6 Demolition of existing ductwork and fan on the roof of the Aerobic Digester Control Building.
- .7 Install new supply and exhaust fans to ventilate the Aerobic Digester Control Building basement, including necessary wall penetrations.
- .8 Permanently seal existing Aerobic Digester Control Building ground floor door and install new door in the location of the original doorway leading outside the building.
- .9 Replace damaged electrical equipment in the Aerobic Digester Control Building.
- .10 Demolish the starters as shown on the demo drawings from MCC in the Digester control building.
- .11 Supply and install 2 VFD and 2 Softstarter panel as shown on the contract drawings.
- .12 Provide power to existing sludge pumps, supernatant pumps, and new ventilation systems.
- .13 Replace 2 supernatant pump motors and replace 1 sludge pump motor.
- .14 All items as shown on the Contract Drawings and as detailed in these specifications.
- .15 Contract method: Standard Construction Document CCDC-2 2020 Stipulated Price Contract

.2 The Owner reserves the right to delete items from the tendered work, prior to contract award, if the tender prices exceed the project budget.

1.3 WORK BY OTHERS

.1 The scope of work identified will be undertaken as a single Contract.

1.4 WORK COMPLIANCE

.1 Provide all work conforming to the lines, levels and grades specified or shown on the Contract Drawings.

.2 Build all Works in a thoroughly substantial and workmanlike manner, in accordance with the Contract Drawings and Specifications, subject to such modifications and additions as may be deemed necessary during its execution. In no case will payment be made for any work in excess of the requirements of the Drawings and Specifications, unless approved in writing by the Engineer and the City.

1.5 ENGINEERING DESIGN

.1 Where specifications require work to be designed by an engineer, engage an engineering firm with a valid Certificate of Authorization with the Professional Engineers Ontario to design such work, and to stamp and sign any drawings and calculations forming part of that design. The engineering firms must also provide proof of Errors and Omissions insurance as per the Special Provisions General Supplementary.

1.6 EXISTING SERVICES

.1 Owner will occupy plant during entire construction period for execution of normal operations of the plant.

.2 Coordinate construction works with the Owner in order to minimize conflict and to facilitate continual operation of the existing wastewater treatment plant until construction works are completed.

.3 Where Work involves breaking into or connecting to existing services, give the Engineer 72 hours-notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance.

.1 Submit a schedule four weeks in advance of work to obtain approval from Engineer for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.4 Provide temporary services as required to maintain critical systems.

.5 Where unknown services are encountered, immediately advise Engineer and confirm findings in writing.

.6 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

.7 Record locations of maintained, re-routed and abandoned service lines.

1.7 WORK SEQUENCE

.1 It is the intent of these documents that the Contract be carried out with the minimum possible interference to the normal operation of the existing wastewater treatment plant that remain in operation.

.2 Any disruption of plant operating facilities must be accommodated by temporary facilities to the satisfaction of the Engineer.

.1 The following items describe the temporary bypass procedure for the MCC 6 work scope, which requires a shutdown of the screw pumps, to occur.

.1 The temporary bypass system shall be designed to transport mixed liquor from the screw pump channel to the secondary clarifiers while the screw pumps are turned off for MCC 6 electrical work to occur. The bypass procedure shall take place during dry weather conditions.

.2 The Contractor shall submit a temporary bypass plan for Engineer's review. Identify environmental protection measures in accordance with the Environmental Procedures specification.

.3 The start point of the bypass system shall be the screw pump channel wet well downstream the aeration tanks. The discharge point shall be either the drop chamber at the top of the screw pump channel or the top-of-concrete access hatch to the secondary clarifier feed chamber.

.4 The pumping system rated capacity shall be 260 L/s with capability to throttle flow rate to match plant operating conditions.

.5 Bypass pumps shall be capable of handling raw sewage.

.6 The elevation difference from the wet well floor to the top of the screw pump channel is 10 m. The elevation difference from the wet well floor to the top-of-concrete access hatch to the secondary clarifier feed chamber is 8 m.

.7 The Contractor shall provide and install fully restrained pipe to transport the mixed liquor.

.8 Temporary power to be provided by Contractor.

.9 Provide freeze protection measures if this work occurs when temperature at site falls below 5°C.

.10 Any electrical components of the bypass pumping system shall be rated for the applicable electrical safety and fire protection code requirements.

.11 Temporary piping shall be pressure tested prior to service.

.12 All components of the temporary bypass pumping system shall be removed and affected areas restored to original or better condition after the bypass.

.13 Refer to Hours of Work for scheduling constraints.

.3 The first progress payment will not be approved until an appropriate schedule with sufficient detail is submitted and accepted.

.4 Submit shop drawings in a timely fashion and in accordance with these Contract Specifications.

.5 Coordinate construction of work with Construction Schedule and with City Occupancy.

.6 The construction sequence shall be in conformance with the requirements of the project, the constraints identified and shall be subject to the Engineer's approval.

.7 Maintain fire access/control.

1.8 CONTRACT DRAWINGS

.1 For easy reference, the Contract Drawings have been divided into disciplines. However, all Drawings shall be read in conjunction with one another, since details applicable to one discipline may appear on the Drawings of another discipline.

.2 Additional drawings may be supplied from time to time by the Engineer during the construction of the Works for information and/or clarification to assist the Contractor, and will not become a basis for extra payment. Drawings covering additional work may be supplied by the Engineer during performance of the Contract, and that work may qualify for additional payment.

.3 Contract Drawings give general location of existing facilities/utilities. The Contractor shall confirm the location of the existing facilities/utilities, and identify any interferences. Where interferences are identified, the Contractor shall propose a possible solution addressing the interference to the satisfaction of the Engineer.

.4 Assume dimensions shown on contract drawings are correct ±50 mm for bidding purposes. Contractor / vendor must field measure during shop drawing preparation prior to first submittals to confirm all dimensions.

1.9 SITE EXAMINATION

.1 Before submitting their Tender, the Contractor shall examine the job site, soil conditions, construction, and waste and storage areas; compare plans and specifications with existing conditions; and fully satisfy themselves as to all data and matters required for the completion of the contract.

.2 Failure to acquaint themselves fully with all available information concerning conditions affecting the Work shall not relieve the Contractor of the responsibility for estimating the difficulties and costs of satisfactorily performing the Work.

1.10 PERMITS LICENSES, REGULATIONS & ACTS

.1 The Contractor shall be responsible for obtaining and paying, for any and all permits or licenses as may be required for any portion of this contract. The Contractor shall comply with all Municipal and Provincial Government regulations as they apply to the work of this contract.

1.11 DRAWINGS AND SPECIFICATIONS FURNISHED

.1 Owner Responsibilities:

.1 Provide PDF copy of project specifications and drawings to Contractor. Printed copies will NOT be provided.

.2 Contractor Responsibilities:

.1 Print copies of drawings and specifications as required.

.2 Maintain at Site, one complete set of drawings and specifications. Make available to Engineer at any time.

.3 Maintain and update one (1) set of construction “Record Drawings” (i.e. Red Lines) on site during construction. The Engineer and Constructor shall review these record drawings once per week Record drawings are to be made available to the Engineer for review anytime and shall be submitted to the Engineer upon completion of construction.

1.12 DETAILED WORK SCHEDULE

.1 In addition to General Conditions, the Contractor shall provide the Owner with a detailed work schedule in the form of a Gantt Chart. The schedule shall include the following activities as a minimum:

.1 Mobilization;

.2 Temporary service install;

.3 Tie-ins to existing services;

.4 Commissioning; and,

.5 Site cleanup, restoration and demobilization.

.2 Contractor shall identify critical path items and long lead items, and order all long lead equipment, such as vortex removal equipment, as soon as receiving order to commence work. Contractor shall provide a schedule detailing long lead equipment delivery times.

.3 There will be other construction work occurring at the plant and the Contractor is to accommodate in their schedules that there may be times when work areas or times may need to be shifted to ensure that the City does not become the constructor. This highlights the importance of a well-planned schedule so that conflicting periods can be identified early and accommodations implemented to mitigate impact on Contractor and City.

1.13 HOURS OF WORK

.1 The Contractor must comply with local by-laws and regulations (i.e. noise, etc.).

.2 Extended hours of operation may be allowed upon written request by the Contractor for review and approval by the City.

.1 The temporary bypass procedure described in Work Sequence may be performed between the hours of 6 pm to 6 am.

.3 During other plant shut-down periods, continuous twenty-four (24) hour work by the Contractor may be allowed in order to shorten shut-down period upon written request.

1.14 CONTRACTOR USE OF PREMISES

.1 Ascertain boundaries of Site within which work must be confined.

.2 Provide approved security fencing around the work and storage areas in accordance with the Occupational Health and Safety Act.

.3 As provided in the Occupational Health and Safety Act, the Contractor must assume responsibility for all personnel on site. The Engineer may authorize others to have access to the site as necessary.

.4 Ascertain and abide by conditions pertaining to use of easements or rights-of-way.

.5 Assume full responsibility for protection and safekeeping of products/equipment under this Contract.

.6 Obtain and pay for use of additional storage, access or work areas needed for operations under this Contract. All storage areas must be approved by the Engineer prior to use. Materials must be stored so as to ensure the preservation of their quality and fitness for use.

.7 Protect all newly constructed work from damage of any form. Any portion of the work, which is damaged, must be rebuilt at the Contractor's expense to the satisfaction of the Engineer.

.8 The Contractor will be responsible for providing washrooms and temporary power for use by the Contractor and the Engineer.

.9 No smoking will be permitted at the plant or any other City facility.

1.15 ADDITIONAL DEFINITION

.1 In addition to Title of Contract Administrator, Titles Engineer and/or Consultant as state in various sections of the Specifications, means the person, partnership, or corporation designated by the Owner to be the Owner's Representative for the purpose of the Contract.

1.16 SUPPLEMENTARY DRAWINGS

.1 Engineer may furnish supplementary drawings to assist proper execution of work. Such drawings will be issued for clarification only and will have same meaning and intent as if included with plans referred to in Contract Documents.

1.17 SUBSTITUTIONS

.1 The Contract Price is based upon those materials and equipment models identified and named in the detailed Specifications. Substitutions or variations to those specified will not be allowed without formal submittal, review and acceptance in accordance with this section.

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

.3 Coordinate pertinent related work and modify surrounding work as required to complete project under each substitute designated.

.4 This section does not refer to alternative methods of construction but specified materials and equipment.

1.18 REQUESTS FOR SUBSTITUTION

.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.

.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.

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

.4 Request for substitution to be made by written application to the Engineer and 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 necessitate 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.

.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 Completion.

.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.

.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.

.5 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.

1.19 PROJECT MEETINGS

.1 The Engineer and Owner will administer preconstruction meeting and progress meetings to be held at intervals as determined by the Engineer.

.2 Contractor's superintendent and senior representatives of major Subcontractors are to attend all meetings.

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

.3 Where required, the Contractor shall provide physical space for the meetings.

.4 Preconstruction Meeting:

.1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Senior representatives of the Owner, Engineer, Contractor, and major Subcontractors will be in attendance.

.3 The Engineer will establish time and location of meeting and notify parties concerned minimum 5 days before meeting.

1.20 SCAFFOLDING

.1 Scaffolding in accordance with CAN/CSA-S269.2.

1.21 HOISTING

.1 Hoists and cranes to be operated by qualified operator.

1.22 MATERIALS TO BE SALVAGED

.1 Remove, clean, deliver, unload and neatly stockpile at site materials which are specified or designated by Engineer to be salvaged.

.2 Repair or replace at Contractor's expense salvaged materials damaged during removal, unloading or in transit.

.3 Provide Owner first right of refusal.

1.23 EXISTING CONDITIONS

.1 Buried services:

.1 Before commencing work verify location of buried services on and adjacent to site.

.2 Confirm locations of buried utilities by careful test excavations.

.3 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.

.4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.5 Maintain and protect from damage, water, sewer, gas, electric, telephone, and other utilities and structures encountered.

.6 Where utility lines or structures exist in area of excavation, obtain direction of Engineer before removing or re-routing.

.7 Record location of maintained, re-routed, and abandoned underground lines.

.8 Confirm locations of recent excavations adjacent to area of excavation.

.9 Prior to beginning excavation Work, notify Consultant and authorities having jurisdiction establish location and state of use of buried utilities and structures.

.2 Existing buildings and surface features:

.1 Conduct, with Engineer, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey benchmarks, and monuments which may be affected by Work.

.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair to approval of Engineer.

.3 Where required for excavation, cut roots or branches as approved by Engineer.

1.24 JOB SITE DOCUMENTS

.1 Maintain at job site, one copy each document as follows:

.1 Contract Drawings
.2 Specifications
.3 Addenda
.4 Reviewed Shop Drawings
.5 List of Outstanding Shop Drawings
.6 Change Orders
.7 Other Modifications to Contract
.8 Field Test Reports
.9 Copy of Approved Work Schedule
.10 Health and Safety Plan and Other Safety Related Documents
.11 Other documents as specified

1.25 SANITARY FACILITIES

.1 The Contractor shall provide sanitary facilities for the workers on the project.

1.26 SITE CONTAINMENT AND PROTECTION

.1 Install the construction fencing around all work areas. Maintain access for public and private residences and properties.

.2 Contractor shall develop a plan that outlines the measures they will implement to contain the site and protect the public. Plan shall be submitted to, discussed with, and approved by the Owner and Engineer prior to mobilization.

.3 At a minimum plan shall include placement of fencing around the work sites, equipment and material staging areas, etc.

.4 Provisions should be provided to allow pedestrian traffic around the work site, while still providing adequate protection and space for the work to be performed.

.5 Contractor may need to assess Site Containment and Protection as the Work progresses and adjust fencing and protection measures based on actual flow of pedestrians and work progress.

.6 Contractor shall maintain protection measures throughout the duration of the project and shall immediately address concerns raised by the Owner or Engineer.

.7 Construct temporary barriers around trees designated to remain prior to construction as directed by the Engineer.

.8 Replace any trees designated to remain, if damaged, as directed by the Engineer or as indicated on Contract Drawings, at no additional cost to the Owner.

1.27 CHECKING OF DIMENSIONS

.1 Carefully check dimensions of structures shown on the Drawings before commencing work thereon. Notify the Engineer of any errors or discrepancies.

.2 Where equipment is to connect to existing, preliminary dimensions have been shown on the Drawings. These dimensions have not been taken from final Shop Drawings. Contractor to confirm all dimensions.

1.28 QUALITY CONTROL

.1 Inspection

.1 Owner and Engineer shall have access to Work.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Engineer instructions, or law of Place of Work.

.3 If 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.

.2 Independent Inspection Agencies

.1 If required, independent inspection/testing agencies will be engaged by Engineer for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Owner.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Reports

.1 Submit 1 copy of mix designs and inspection and test reports promptly to Engineer.

.2 Provide copies to Subcontractor of work being inspected/tested.

1.29 PROJECT CLOSEOUT

.1 Final Cleaning

.1 When the Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste materials and debris from site at regularly scheduled times or dispose of as directed by Engineer. Do not burn waste materials on site, unless approved by Engineer.

.2 Systems Demonstration

.1 Prior to final inspection, demonstrate operation of each system to Owner and Engineer.

.2 Instruct personnel in operation, adjustment, and maintenance of equipment and systems, using provided operation and maintenance data as basis for instruction.

.3 Documents

.1 Collect reviewed submittals and assemble documents executed by Subcontractors, suppliers, and manufacturers.

.2 Submit material prior to final Application for Payment.

.3 Submit operation and maintenance data, record drawings.

.4 Execute transition of Performance and Labour and Materials Payment Bonds to warranty period requirements.

.5 Submit a final statement of accounting giving total adjusted Contract Amount, previous payments, and monies remaining due.

.6 Engineer will issue a final change order reflecting approved adjustments to Contract Amount not previously made.

.4 Inspection/Takeover Procedures

.1 Prior to application for Certificate of Total Performance, carefully inspect the Work and ensure it is complete, that all construction deficiencies are complete, defects are corrected, and building is clean and in condition for occupancy. Notify Engineer, in writing, of completion of the Work and request an inspection.

.2 During Engineer inspection, a list of deficiencies and defects will be tabulated. Correct same.

.3 Make application for Certificate of Total Performance.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 MEASUREMENT FOR PAYMENT

.1 For lump sum price item, Engineer will calculate payment based on tendered price and Engineer's estimate of percentage of work item completed.

.2 For each unit price item, Engineer will calculate payment based on tendered unit price and Engineer's determination of units of work item completed.

.3 Where a method of measurement for payment for a work item is not specified, payment for that item will be deemed to be included in another pay item or other pay items.

1.2 PROGRESS PAYMENTS

.1 Refer to CCDC 2 Part 5 Payment.

1.3 CHANGES

.1 Refer to CCDC 2 Part 6 Changes in Work.

1.4 PAYMENT ITEMS

.1 GENERAL REQUIREMENTS

.1 METHOD OF MEASUREMENT: for GENERAL REQUIREMENTS shall be based on 50% of the lump sum price paid upon completion of mobilization and the remaining 50% equally divided by the duration of construction (in months) and that amount paid monthly.

.2 BASIS OF PAYMENT: Payment for GENERAL REQUIREMENTS shall be paid for at the Contract Lump Sum Price shown in the Bid Form.

.1 Lump sum price shall not exceed 10% of the total bid.

.2 Price includes labour, equipment and materials, and work incidental to permits; insurance, bonding, mobilization; demobilization; temporary signage; temporary fencing; and other work required for setting up the Work.

.2 STRUCTURAL WORKS

.1 METHOD OF MEASUREMENT: “STRUCTURAL WORKS” shall be based on the percentage (%) complete of the Lump Sum Price.

.2 BASIS OF PAYMENT: Payment for “STRUCTURAL WORKS” shall include work related to all structural works noted on plans. Includes hatch works, new door supply and installation and other works in the Existing Main Floor Aerobic Digester Control Building as shown on the plans. Includes hatch work, gasket retrofits and all other works in the Existing Second Flood – Screw Pump Building.

.3 HVAC MECHANICAL WORKS

.1 METHOD OF MEASUREMENT: “HVAC MECHANICAL WORKS” shall be based on the percentage (%) complete of the Contract Lump Sum Price.

.2 BASIS OF PAYMENT: Payment for “HVAC MECHANICAL WORKS” shall include work related to supply, construction, installation, and testing of all building HVAC systems, equipment, controls and associated works. All other related material and work shall be considered incidental thereto.

.4 ELECTRICAL WORKS

.1 METHOD OF MEASUREMENT: “ELECTRICAL WORKS” shall be based on the percentage (%) complete of the Contract Lump Sum Price.

.2 BASIS OF PAYMENT: Payment for “ELECTRICAL WORKS” shall include work related to the selective demolition as noted in the plans, trenching and backfill required for underground power, wiring and/or connecting of equipment provided by other trades, equipment and panel supply, Instrumentation and Controls and associated works. All other related material and work shall be considered incidental thereto.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Construction schedule

.2 Shop drawings and product data

.3 Samples

.4 Operating and maintenance manuals

.5 Record drawings

.6 Warranty Certificates

1.2 ADMINISTRATIVE

.1 Provide to Engineer for review the submittals specified. Submit with reasonable promptness and in an orderly sequence so as to not cause delay in the Work. 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.

.2 All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be shown on all submissions for Engineer review.

.3 At Engineer's request, prepare and submit schedule fixing the dates for submission and return of shop drawings, product data or samples.

.4 Do not proceed with Work affected by the submittal until review is complete.

.5 Review submittals prior to submission to Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project will be returned without being examined and shall be considered rejected.

.6 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents and stating reasons for deviation.

.7 Verify that field measurements and affected adjacent Work are coordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer review.

.10 Keep one reviewed copy of each submission on Site.

1.3 CONSTRUCTION SCHEDULE / WORK PLAN

.1 Refer to Specifications.

1.4 WORK PLANS

.1 Provide Work Plans for each key activity, as requested by Engineer, to show construction methods. Relate Work Plan to activities shown on Construction Schedule.

1.5 SHOP DRAWINGS AND PRODUCT DATA

.1 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, wiring diagrams, panel layouts with bills of material, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.2 Adjustments made on shop drawings by Engineer are not intended to change the Contract Amount. If adjustments affect the value of Work, state such in writing to Engineer prior to proceeding with Work.

.3 Make such changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of any revisions other than those requested.

.4 Submissions shall include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

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

.5 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 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

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

.1 "REVIEWED" - Make and distribute additional copies as required for execution of Work.

.2 “REVIEWED AS NOTED” – This notation indicates when Engineer has provided notations on the shop drawings that must be incorporated into the goods or work. Make and distribute additional copies as required for execution of the work.

.3 "REVISE & RESUBMIT" - Make the necessary revisions and resubmit revised drawings for review. Show the drawing number of the first such revised drawing and show the latest revision number applicable to the drawing by adding a suffix to the drawing number as - "REV. 1", "REV. 2", etc.

.4 "NOT REVIEWED" - This notation indicates when Engineer has not reviewed the drawing. It may also be used in combination with the notation to revise and resubmit the drawing where Engineer lacks sufficient information to complete the review and requires resubmitting the drawing for review after revision.

.5 Drawings will be marked "REVIEWED" together with the notation to "REVISE & RESUBMIT" when Engineer requires Contractor to resubmit a revised drawing showing corrections made as a result of Engineer's notations on the shop drawings. This procedure will not relieve Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of Contract.

.6 Use only those shop drawings on the work that bear the "REVIEWED" notation.

.7 Do not revise shop drawings marked "REVIEWED" unless resubmitted to Engineer for further review.

.8 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 shall be submitted together, to enable Engineer to review the drawings as a package.

.9 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.

.10 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.

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

.12 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 or Territory where the work is located, 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.

.13 Owner may deduct, from payments due to Contractor, costs of additional engineering work incurred if correct shop drawings are not submitted after one review by Engineer.

.14 Review by Engineer is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Engineer approves the detail design inherent in the shop drawings, responsibility for which remains with Contractor, and such review does not relieve Contractor of the responsibility for errors or omissions in the shop drawings or of the responsibility for meeting all requirements of the Contract Documents. 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.

.15 Shop drawings for the following structural components shall bear the seal of a registered engineer of Ontario:

.1 Shoring

.2 Structural steel/aluminum

.3 Structural connection details

.4 Concrete formwork and falsework as required by Engineer.

.5 Pre-Engineered Building Components.

.16 Samples

.1 Submit for review, as requested in respective specification Sections.

.2 Deliver samples prepaid to Engineer's business address.

1.6 OPERATIONS AND MAINTENANCE MANUALS

.1 Submit Operating and Maintenance Manuals to Engineer, per Specification Section.

1.7 RECORD DRAWINGS

.1 After award of Contract, Engineer will provide a set of drawings for the purpose of maintaining record drawings. During progress of the work, accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by Engineer.

.2 Record locations of concealed components of mechanical and electrical services.

.3 Record following information:

.1 Significant deviations from the contract documents caused by site conditions and changes ordered by the Engineer.

.2 Horizontal and vertical location of piping, underground utilities and appurtenances referenced to permanent surface improvement.

.3 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

.4 Location and elevation of all crossed utilities during piping installation.

.5 Field changes of dimension and detail.

.6 Depths of various elements of foundation in relation to finished floor.

.7 Changes made by Change Order or field direction.

.8 Location of all installed equipment and electrical.

.4 Contractor shall provide complete AutoCAD 2010 record drawings of all Electrical and Instrumentation and Control Drawings. Drawings shall include all modifications made by addenda, change orders, site instructions, RFC's, RFI's, etc.

.5 Identify drawings as "Project Record Copy". Maintain in good condition, keep continuously updated and make available for inspection on site by Engineer.

.6 On completion of Work and prior to final inspection, submit record documents to Engineer.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section outlines the Contractor's responsibilities for environmental requirements for this Work.

.2 The environmental controls shall be in accordance with the Owner’s General Conditions and as amended or extended herein.

.3 Furnish all labour, materials, and equipment necessary to install and maintain environmental protection systems.

1.2 CONSTRUCTION CLEANING

.1 Maintain the Work in tidy condition, free from the accumulation of waste products and debris, other than that caused by Owner or other contractors.

.2 Remove waste material and debris from the site at the end of each day that work takes place.

.3 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

.4 Promptly clean up any spillage that occurs on site roads, access roads or public roads, or other areas where construction vehicles are travelling.

.5 If Contractor is negligent in maintaining cleanliness of roads, Owner will arrange for cleaning to be done at Contractor's expense.

1.3 DISPOSAL

.1 Do not bury rubbish and waste materials on site unless approved, in advance, by Engineer.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into lagoon, waterways, storm or sanitary sewers.

.3 Remove from Site wastes and materials specified or designated by Engineer to be disposed of. Dispose of these wastes and materials at sites provided by Contractor.

1.4 FIRES

.1 Fires and burning of rubbish on site not permitted.

Part 2 Products

.1 Not Used

Part 3 Execution

3.1 DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep site free from surface water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.4 Maintain existing drainage facilities affected by Work in good operating condition at all times during construction.

.5 Clean up all drainage areas upon completion of Work.

3.2 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under the Contract.

.2 Control emissions from equipment and plant to requirements of authorities having jurisdiction.

.3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

.4 Establish suitable fueling and maintenance areas and review with the Engineer.

.5 Do not refuel or maintain equipment adjacent to or in watercourses.

.6 Do not fuel equipment within thirty (30) metres of any water course unless non-spill facilities are used.

.7 Submit procedures for interception, rapid clean up and disposal of spillages that may occur, for Engineer's review, prior to commencing Work.

.8 Be prepared at all times to intercept, clean up and dispose of any spillage that may occur whether on land or water.

.9 Keep all materials required for clean up of spillages readily accessible on site.

.10 Report immediately any spills causing damage to the environment to Spills Action Centre of the Ministry of the Environment.

.11 Do not empty fuel, lubricants or pesticides into sewers or watercourses.

.12 Dispose of all construction debris in an approved location.

.13 Clean construction equipment prior to entering public roadways to prevent litter or mud from being deposited on to the roads

3.3 SPILLS REPORTING

.1 Be responsible for the adverse effects of a spill including all costs associated with clean-up and remediation of any contaminants. The discharger is expected to contain and clean up the spilled contaminant or arrange for the contaminant to be contained and cleaned up. The discharger is also expected to restore the spill site to pre-spill conditions where this can reasonably be expected. To achieve this, the discharger may have to remove the contaminated soil and debris and dispose of these materials in accordance with the applicable environmental legislation at an approved disposal site.

.2 Prior to commencing construction, the Contractor is to prepare and submit for approval, a contingency plan for the control and clean up of a spill. This plan must adhere to the requirements and regulations of he WHMIS (Work Hazardous Material Information

System) and shall include the applicable MSDS (Material Safety Data Sheet) for each substance.

.3 In the event of a spill or other emission of a pollutant into the natural environment, every person responsible for the emission or who causes or permits it must forthwith notify:

.1 The Ministry of the Environment Spills Action Centre (SAC)

.2 The owner of the pollutant, if known;

.3 The person having control of the pollutant, if known; and

.4 The Owner and the Engineer, including the nature of the spill, of the circumstances thereof, and of the action taken or intended to be taken with respect thereto.

3.4 BLASTING/SUB-SURFACE MATERIAL REMOVAL

.1 Blasting will **not** be permitted.

3.5 NOISE CONTROL

.1 The Contractor shall establish and maintain site procedures such that noise levels from construction areas are minimized.

.2 Use vehicles and equipment equipped with efficient muffling devices.

.3 Provide and use noise attenuation devices (barriers) that will minimize noise level in construction area.

.4 Comply with noise bylaws.

3.6 DUST CONTROL

.1 Prevent dust nuisance resulting from construction operations at all locations on site.

.2 Use water, brine or calcium chloride to control dust.

.3 Minimize use of calcium or brine, particularly in close proximity to sewers, wastewater treatment facility, watercourse or agricultural lands.

.4 Transport dusty materials in covered haulage vehicles.

.5 Public roadways shall be kept clean and free of mud.

.6 Dust control shall be at the Contractor's expense and to the satisfaction of the Engineer.

3.7 CONTINGENCY PLAN

.1 Prior to commencing construction, prepare a contingency plan for the control and clean up of a spill. The contingency plan to include:

.1 The names and the telephone numbers of the persons in the local municipalities to be notified forthwith of a spill.

.2 The names and the telephone numbers of the representatives of the fire, the police and the health departments of the local municipalities who are responsible to respond to emergency situations.

.3 The names and the telephone numbers of the companies experienced in the control and clean up of hazardous material that would be called upon in an emergency involving a spill.

.4 The Contractor's proposal for the immediate containment and control of the spill, the clean-up procedures to be initiated immediately and any other action to be taken to mitigate the potential environmental damage while awaiting additional assistance.

.5 The name and the telephone number to the Contractor's representative responsible for preparing, implementing, directing and supervising the contingency plan.

.2 The Contractor shall ensure the immediate availability of the products with which to effect temporary repair to broken pipelines and other services so the spill or other emission of a pollutant is immediately controlled and stopped and to mitigate the damages.

.3 Submit for the Engineer's review, a copy of the Contingency Plan and make appropriate changes to it based upon the feedback received.

3.8 RE-INSTATEMENT

.1 Where directed by Engineer, Contractor to make good all damages caused to the site to the satisfaction of the Engineer.

.2 All surplus material to be removed and disposed of off-site at no extra cost to the Owner.

END OF SECTION

Part 1 General

1.1 REQUIREMENTS INCLUDED

.1 Regulations affecting the Work imposed by:

.1 Fisheries and Oceans Canada.

.2 Environment Canada.

.3 Ontario Building Code

.4 Occupational Health and Safety Act

.5 Ontario Fire Code

.6 Municipal by-laws and servicing standards

.7 Municipal utilities

.8 Ontario Electrical Safety Code.

.9 Design Reference Standards as captured within the individual specification sections.

1.2 COMPLIANCE WITH REGULATIONS

.1 Ascertain requirements and regulations of authorities listed above.

.2 Comply with all such requirements and regulations as applicable to the Work.

.3 Requirements set out in this Section are for guidance and information and are not necessarily complete.

1.3 CODES AND STANDARDS

.1 The Contractor shall:

.1 Perform Work in accordance with the latest named published editions of codes and standards.

.2 Provide materials and workmanship, which meet or exceed the specifically named code or standard.

.3 Execute Work in accordance with the applicable Federal, Provincial, Territorial, Municipal, and town 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 standards and practices.

.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 shall 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 the Construction Health and Safety Branch of the Ministry of Labour with the information required under Section 4 of the Ontario Regulation 691/80 prior to commencing Work.

1.4 PERMITS

.1 The Contractor shall be responsible for obtaining and paying, for any and all permits or licenses as may be required for any portion of this contract. The Contractor shall comply with all Municipal and Provincial Government regulations as they apply to the work of this contract.

.2 The Owner will secure the approval from the Ontario Ministry of Environment as required.

1.5 WORK IN VICINITY OF OVERHEAD POWER LINES

.1 Contractor to confirm the following setback requirements for operation near power lines with local utility.

.2 Request power company to relocate, de-energize or guard any energized conductor where construction equipment may operate within 3 m of conductor.

.3 Obtain power company approval prior to operating any equipment within 3 m of energized conductor.

.4 Where practical, avoid storage of metallic pipe sections under high voltage overhead power lines.

.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.

.6 Complete and submit applicable Workplace Safety and Insurance Board (WSIB) Forms prior to commencement of Work.

1.6 PERFORMING HOT WORK

.1 Hot work to be carried out under the Contract includes, but is not limited to:

.1 Performing welding, cutting, grinding, braising or soldering work:

.1 In Class 1, Zone 1 locations

.2 In confined spaces which contain or may contain an explosive or flammable hazard.

.3 In or on equipment designated by the Owner as being potentially hazardous due to the possible presence of flammable gases, dust or vapours.

.4 In Hazardous room.

.5 Outside of designated areas.

.2 The contractor shall execute work in accordance with The Hot Work Policy from The Owner.

Part 2 Products

.1 Not Used.

Part 3 Execution

.1 Not Used.

END OF SECTION

Part 1 General

1.1 LATEST EDITIONS

.1 All references to specifications, standards, or methods of technical associations refer to the latest adopted revision, including all amendments, in effect on the date of submission of bids, except where a date or issue is specifically noted.

1.2 ABBREVIATIONS

.1 AASHTO American Association of State Highway and Transportation Officials

.2 ACI American Concrete Institute

.3 AFBMA Antifriction Bearing Manufacturers Association

.4 AGA American Gas Association

.5 AGMA American Gear Manufacturers Association

.6 AISC American Institute of Steel Construction

.7 AISI American Iron and Steel Institute

.8 AMCA Air Moving and Conditioning Association

.9 ANSI American National Standard Institute

.10 API American Petroleum Institute

.11 APWA American Public Works Association

.12 ARI Air-Conditioning and Refrigeration Institute

.13 ASCE American Society of Civil Engineers

.14 ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers

.15 ASME American Society of Mechanical Engineers

.16 ASTM American Society for Testing and Materials

.17 AWMAC Architectural Woodworkers Manufacturers Association of Canada

.18 AWPA American Wood Preserver's Association

.19 AWS American Welding Society

.20 AWWA American Water Works Association

.21 CAN Canadian National Standard

.22 CBM Certified Ballast Manufacturers

.23 CBTIC Clay Brick and Tile Institute of Canada

.24 CEC Canadian Electrical Code

.25 CEMA Canadian Electrical Manufacturers Association

.26 CGA Canadian Gas Association

.27 CGRA Canadian Good Roads Association

.28 CGSB Canadian General Standards Board

.29 CISC Canadian Institute of Steel Construction

.30 CITC Canadian Institute of Timber Construction

.31 CLA Canadian Lumbermen Association

.32 CMAA Crane Manufacturers Association of America

.33 CMHC Canada Mortgage and Housing Corporation

.34 CPCA Canadian Painting Contractors Association

.35 CPCI Canadian Prestressed Concrete Institute

.36 CRCA Canadian Roofing Contractors Association

.37 CRSI Concrete Reinforcing Steel Institute

.38 CSA Canadian Standards Association

.39 CSSBI Canadian Sheet Steel Building Institute

.40 CUA Canadian Underwriters Association

.41 CWB Canadian Welding Bureau

.42 CWC Canadian Wood Council

.43 CSPI Corrugated Steel Pipe Institute

.44 EEI Edison Electric Institute

.45 EEMAC Electrical and Electronic Manufacturers of Canada

.46 FFPC Federal Fire Prevention Committee

.47 FM Factory Mutual Engineering Corporation

.48 HEPC Hydro Electric Power Commission

.49 HI Hydraulic Institute

.50 IAO Insurers' Advisory Organization

.51 IBRM Institute of Boiler and Radiator Manufacturers

.52 IEC International Electrotechnical Commission

.53 IEE Institution of Electrical Engineers (U.K.)

.54 IEEE Institute of Electrical and Electronics Engineers

.55 IES Illuminating Engineering Society

.56 IGMAC Insulated Glass Manufacturers Association of Canada

.57 IPCEA Insulated Power Cable Engineers Association

.58 ISA Instrument Society of America

.59 ISO International Standardization Organization

.60 LEMA Lighting Equipment Manufacturers Association

.61 LTIC Laminated Timber Institute of Canada

.62 MMA Millwork Manufacturers Association

.63 MOEE Ontario Ministry of the Environment

.64 MTO Ministry of Transportation Ontario

.65 NAAMM National Association of Architectural Metal Manufacturers

.66 NBC National Building Code of Canada

.67 NEC National Electrical Code

.68 NEMA National Electrical Manufacturers Association

.69 NESC National Electric Safety Code

.70 NFPA National Fire Protection Association

.71 NLGA National Lumber Grade Authority

.72 NPSCD Niagara Peninsula Standard Contract Document

.73 NSF National Sanitation Foundation

.74 OECI Overhead Electrical Crane Institute

.75 OPSD Ontario Provincial Standard Drawings

.76 OPSS Ontario Provincial Standard Specifications

.77 PCA Portland Cement Association

.78 PCI Prestressed Concrete Institute

.79 RLM RLM Standards Institute

.80 RTAC Road and Transportation Association of Canada

.81 SAE Society of Automotive Engineers

.82 SBI Steel Boilers Institute

.83 SJI Steel Joist Institute

.84 SSPC Steel Structures Painting Council

.85 TTMAC Terrazzo, Tile and Marble Association of Canada

.86 ULC Underwriters' Laboratories of Canada

.87 USFG United States Federal Government

.88 WSIB Workplace Safety and Insurance Board

1.3 CONFORMANCE

.1 Conform to these standards, in whole or in part as specifically requested in Specifications.

.2 If there is 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.

.3 The cost for such testing will be borne by the Region in the event of conformance with Contract Documents or by Contractor in the event of non-conformance.

Part 2 Products

.1 Not Used

Part 3 Execution

.1 Not Used

END OF SECTION

Part 1 General

1.1 INSPECTION AND TESTING

.1 Quality Control shall be in accordance with the Owner's requirements and as amended or extended herein.

1.2 TESTING LABORATORY SERVICES

.1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by Engineer are specified under various sections.

.2 Owner will appoint and pay for services of testing laboratory except for the following:

.1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.

.2 Inspection and testing performed exclusively for Contractor's convenience.

.3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.

.4 Mill tests and certificates of compliance.

.5 Tests specified to be carried out by Contractor under the supervision of Engineer.

.3 Where tests or inspections by designated testing laboratory reveal work not in accordance with contract requirements, Contractor shall pay costs for additional tests or inspections as Engineer may require verifying acceptability of corrected work.

.4 Contractor's Responsibilities:

.1 Furnish labour and facilities to:

.1 Provide access to work to be inspected and tested.

.2 Facilitate inspections and tests.

.3 Make good work disturbed by inspection and test.

.4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

.2 Notify Engineer sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.

.3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

1.3 PAY COSTS FOR UNCOVERING AND MAKING GOOD WORK THAT IS COVERED BEFORE REQUIRED INSPECTION OR TESTING IS COMPLETED AND APPROVED BY ENGINEER.

1.4 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work and offsite manufacturing and fabrication plants.

1.5 PROCEDURES

.1 Notify the appropriate agency and Engineer in advance of the requirement for tests, in order that attendance arrangements can be made.

.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 the Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site.

.4 Provide sufficient space to store and cure test samples.

1.6 REPORTS

.1 Submit copies of inspection and test reports promptly to Engineer.

1.7 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as may be requested.

1.8 CONCRETE QUALITY CONTROL

.1 Take concrete samples as close to the location of the final deposition in the forms as is practical. Concrete sampling procedures to be in conformance with CAN/CSA-A.23.2.

.2 Supply cylinder moulds, sample the concrete, make and cure test cylinders and perform compressive strength tests in accordance with CSA Standards A23.2.1C, A23.2.3C, and A23.2.9C.

.3 Make slump tests and air content tests in accordance with CSA Standards A23.2.5C and A23.2.4C or A23.2.7C for each concrete test.

.4 Concrete test cylinders shall be taken after the addition of plasticizer to the concrete mix.

.5 The Engineer may at his discretion reduce or eliminate the test cylinders to be taken for minor pours or pours not of structural significance.

.6 Testing of concrete shall be performed in accordance with CAN/CSA-A.23.2:

.1 Slump: Make at least one slump test for each strength test.

.2 Air Content: Make at least one air content determination for each strength test.

.3 Temperature: Measure temperature for each strength test and as required by the Engineer.

.4 Strength:

.5 Strength testing to consist of 6 - 150 mm x 300 mm cylinders; one tested at 7 days, at minimum two tested at 28 days and two at 56 days.

.1 At least one strength test shall be made from each 50 m^3 of concrete placed, with a minimum of one test for each pour of a specified concrete strength placed each day.

.2 It may be to the Contractor's benefit to take and test additional cylinders to confirm the concrete has sufficient strength to carry construction loads before 14 days. Any additional tests taken at the request of the Contractor to be paid for by the Contractor.

.3 Strengths shall conform to the following requirements:

.1 Not more than 10% of test cylinders shall have values less than the specified strength.

.2 The average of any five consecutive tests shall be equal to or greater than the specified strength.

.3 No three consecutive cylinders shall fall below the specified strength.

.4 No test cylinder shall fall more than 15% below the specified strength.

.4 Take two additional test cylinders during cold weather concreting. Cure cylinders on jobsite under same conditions as concrete it represents. At the end of 7 days, take the two test cylinders to the laboratory. Test one cylinder immediately without laboratory curing. The other cylinder shall be laboratory cured for 21 days and tested at 28 days.

.5 Field cure samples are to be taken for the slab and fillcrete to confirm field strengths.

1.9 FAILURE TO MEET STRENGTH REQUIREMENTS

.1 If any of the criteria under the proceeding clauses are not met, the Engineer may require:

.1 Changes in the mix proportions for the remainder of the work;

.2 Core testing from the areas in question in conformance with CSA. Cost of core testing to be borne by the Contractor; or

.3 Load testing of the structural element in conformance with NBC.

.2 If after testing as above, the concrete strength is below specified strength, the Engineer may require a strengthening or replacement of the portions that failed to develop specified strength, at the expense of the Contractor. Design reviews incurred as a result of defective materials shall be paid for by the Contractor.

.3 All concrete falling more than 15% below specified strength shall be rejected and shall be removed and replaced at the Contractor's expense.

.4 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2. Make good concrete surfaces after completion of tests.

.5 Inspection or testing by Engineer will not augment or replace Contractor quality control nor relieve the Contractor of the Contractor’s contractual responsibility.

1.10 MILL TESTS

.1 Submit mill test certificates as may be requested.

1.11 EQUIPMENT/SYSTEMS

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

.2 Refer to individual specification sections for definitive requirements.

Part 2 Products

.1 Not Used

Part 3 Execution

.1 Not Used

END OF SECTION

Part 1 General

1.1 WORK DESCRIPTION

.1 Design, supply, install and test interim service systems to ensure there are no service interruptions and to minimize interference with treatment plant operations during construction, as specified herein, and shown on the Drawings and as required to complete the works of this Contract.

.2 Undertake sequence of operations to provide interim service during construction, as stipulated herein and as required to complete the work.

.3 Carry out cutting, patching, drilling, fitting and provision of temporary supports under this Section, as required for temporary systems.

.4 Make all connections to new and existing equipment as required and as shown on the Drawings. Cooperate with all trades working on this contract to achieve consistent and total operation of facilities.

.5 Supply and install all products necessary for making temporary connections to equipment and facilities.

1.2 SUBMISSIONS

.1 Submit detailed schedule with description of temporary facilities and related shop drawings for review, for all items included in this Section.

1.3 TEMPORARY POWER AND LIGHT

.1 Contractor to supply their own power during construction for temporary lighting, heating, and operating of power tools etc.

.2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.

.3 Provide and maintain temporary lighting throughout project.

.4 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Consultant provided that guarantees are not affected and the Owner is reimbursed for all utility usage bills up until the facility is turned over. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.

1.4 WATER SUPPLY

.1 Arrange, pay for and maintain temporary water supply as required.

.2 Locate temporary water supply at a location acceptable to Engineer.

1.5 DEWATERING

.1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

.2 The Contractor shall pay for and maintain all necessary equipment and incidentals required for dewatering of the excavation and the site. The Contractor shall also maintain the excavation and site in proper condition to allow dewatering to occur.

1.6 TEMPORARY HEATING AND VENTILATION

.1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.

.2 Construction heaters used inside building must be vented to outside or be of flameless type. Solid fuel salamanders are not permitted.

.3 Provide temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate progress of Work.

.2 Protect Work 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.

.4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.

.5 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 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.

.6 Permanent heating system of building may be used when available. Be responsible for damage to heating system if use is permitted.

.7 On completion of Work for which permanent heating system is used, replace filters.

.8 Pay costs for maintaining temporary heat.

.9 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.

.10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.7 MATERIALS HANDLING AND STORAGE

.1 Safely deliver all materials to the sites. Handle materials with care to avoid damage. Load, unload and move materials into place by means of hoists, ropes or skidways in such a manner as to avoid shock. Do not drop materials or roll them against one another.

.2 Properly store and protect equipment on sites against weather, damage and theft to the satisfaction of the Engineer.

1.8 JOB CONDITIONS

.1 Coordinate activities with all relevant organizations, including Hydro, Gas, telephone, cable television, Owner's operating staff and the Owner/Local Public Works Department.

.2 Operate or shut down existing equipment and facilities only with express consent and under direct supervision of the relevant plant or public works staff.

.3 Limit specific equipment or system operating disruptions (shut-downs) not to exceed the maximums specified herein or as required to maintain plant operations.

.4 In the event that adherence to the foregoing limitations on shutdowns is not sufficient to permit the plants to maintain service to consumers, the Owner reserves the right to impose more restrictive limitations on shutdowns.

1.9 INSTALLATION/REMOVAL

.1 Provide temporary utilities in order to execute the work expeditiously.

.2 Make necessary applications to authorities having jurisdiction, obtain required permits, and pay all fees and related charges.

.3 Remove from site all such work after use.

.4 Restore site to clean, sanitary condition.

.5 Location of all temporary utilities to be approved by the City and Engineer.

1.10 MAINTENANCE OF PUBLIC UTILITIES

.1 Arrange Work to avoid interruption of utilities serving the public. Pay for damage.

.2 Where interruption of public utilities is unavoidable, obtain prior approval for interruption from responsible authority.

.3 As required by utility authority, establish and pay for temporary relocation of utility during construction.

.4 Comply with utility authority requirements in giving notice to users and fire department prior to interruption of service.

1.11 FIRE PROTECTION

.1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.

.2 Burning rubbish and construction waste materials is not permitted on site.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

.1 Not Used.

END OF SECTION

Part 1 General

1.1 CONSTRUCTION CLEANING

.1 Maintain the Work in tidy condition, free from the accumulation of waste products and debris, other than that caused by Owner or other contractors.

.2 Remove waste material and debris from the site at the end of each working day.

.3 Promptly clean up any spillage that occurs on site roads, access roads or public roads, or other areas where construction vehicles are travelling.

.4 If Contractor is negligent in maintaining cleanliness of roads, Owner will arrange for cleaning to be done at Contractor's expense.

1.2 FIRES

.1 Fires and burning of rubbish on site not permitted.

1.3 DISPOSAL OF WASTES

.1 Do not bury, or permit to be buried, rubbish and waste materials on site unless approved by Engineer.

.2 Do not dispose, or permit the disposal, of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

.3 Remove from Site wastes and materials specified or designated by Engineer to be disposed of. Dispose of these wastes and materials at sites provided by Contractor, or as specified by the Engineer.

1.4 DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from surface and ground water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.4 Maintain existing drainage facilities affected by Work in good operating condition at all times during construction.

1.5 WORK ADJACENT TO WATERWAYS

.1 Do not operate construction equipment in waterways unless specifically authorized to do so.

.2 Do not clean equipment in watercourses or in locations where debris can gain access to sewers.

.3 Do not use waterway beds for borrow material.

.4 Do not dump excavated fill, waste material, debris, or other extraneous material in waterways under any circumstances.

.5 Design and construct temporary crossings to minimize erosion to waterways.

.6 Do not skid logs or construction materials across waterways.

.7 Avoid indicated spawning beds when constructing temporary crossings of waterways.

.8 Do not blast under water or within 100 m of indicated spawning beds.

1.6 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this contract.

.2 In addition to 1.6.1, comply with all requirements of appropriate regulating agencies.

.3 Control emissions from equipment and plant to requirements of authorities having jurisdiction.

.4 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

.5 Establish suitable fuelling and maintenance areas and review with the Engineer.

.6 Do not refuel or maintain equipment adjacent to or in watercourses.

.7 Do not fuel equipment within thirty (30) metres of any water course unless non-spill facilities are used.

.8 Submit procedures for interception, rapid clean up and disposal of spillages that may occur, for Engineer’s review, prior to commencing work.

.9 Be prepared at all times to intercept, clean up and dispose of any spillage that may occur whether on land or water.

.10 Keep all materials required for clean up of spillages readily accessible on site.

.11 Report immediately any spills causing damage to the environment to Spills Action Centre of the Ministry of the Environment.

.12 Coordinate use of herbicides and pesticides with landowners and occupants and Ministry of the Environment.

.13 Do not empty fuel, lubricants or pesticides into sewers or watercourses.

.14 Dispose of all construction debris in an approved location.

.15 Schedule construction in sensitive areas so that there will be minimal interference with water uses including fish migration or spawning, or disruption of incubating period of eggs.

1.7 MATERIALS TO BE SALVAGED

.1 Remove, clean, deliver, unload and neatly stockpile materials, which are specified or designated by Engineer to be salvaged.

.2 Repair or replace at Contractor's expense salvaged materials damaged during removal, unloading or in transit.

1.8 NOISE CONTROL

.1 Establish and maintain site procedures such that noise levels from construction areas are minimized. All work must be completed in accordance with City Noise Bylaws.

.2 Use vehicles and equipment equipped with efficient muffling devices.

.3 Provide and use devices that will minimize noise level in construction area.

1.9 DUST CONTROL

.1 Prevent dust nuisance resulting from construction operations at all locations on site.

.2 Use water or calcium chloride to control dust.

.3 Minimize use of calcium, particularly in close proximity to watercourse or agricultural lands.

.4 Transport dusty materials in covered haulage vehicles.

.5 Public roadways shall be kept clean and free of mud.

.6 Dust control shall be completed to the satisfaction of the Engineer.

1.10 MUD CONTROL

.1 The Contractor shall be responsible for all dirt and mud that is tracked onto the site and public roadways from vehicles entering or leaving the job site. He shall, upon request from the Engineer, immediately proceed with clean up operation at his expense. If after repeated requests, or if in the opinion of the Engineer, the Contractor has not or cannot sufficiently remove the mud from the road, the Engineer will proceed with necessary clean up with all costs being charged to the Contractor.

1.11 CONCRETE DEBRIS

.1 The Contractor shall ensure that any construction waste material (i.e., concrete debris, garbage) does not enter the treatment process.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 QUALITY

.1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.

.3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.4 Should disputes arise as to quality or fitness of products, decision rests strictly with the Engineer based upon requirements of Contract Documents.

.5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.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.

1.2 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify the Engineer of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In event of failure to notify the Engineer at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Engineer reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.3 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.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 required in Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.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.

.6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to satisfaction of the Engineer.

.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.

1.4 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

.2 Transportation cost of products supplied by Owner will be paid for by Owner. Unload, handle and store such products.

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, 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.

.2 Notify the Engineer in writing, of conflicts between specifications and manufacturer's instructions, so that the Engineer will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Engineer to require removal and re-installation at no increase in Contract Price or Contract Time.

1.6 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the Engineer if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. the Engineer reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with the Engineer, whose decision is final.

1.7 CO-ORDINATION

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.8 CONCEALMENT

.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation inform the Engineer if there is interference. Install as directed by the Engineer.

1.9 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.10 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform the Engineer of conflicting installation. Install as directed.

1.11 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.12 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for all interior and exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.13 QUANTITIES

.1 Schedules of piping, fittings, reinforcing, or other materials indicating quantity and/or dimension, which are shown on the drawings or in the specifications, are intended only to assist Contractor with quantity takeoff. Quantities and dimensions shown therein are not guaranteed to be accurate and must be checked by Contractor prior to placing an order for such materials.

.2 Claims for additional payment resulting from variations between quantities shown on the schedules and those actually installed will not be accepted.

1.14 OWNERSHIP

.1 All materials provided by Contractor for execution of Work will vest in and become the property of Owner upon delivery to Site, but will remain in the custody and at the risk of Contractor until Final Completion.

1.15 PROTECTION OF WORK IN PROGRESS

.1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of the Engineer.

1.16 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.17 PLANT EQUIPMENT COMPATIBILITY

.1 All materials and equipment shall be suitable for installation in a water plant environment. (i.e. temperature, humidity, moist environment, submerged, etc.). Any and all problems incurred due to environmental factors shall be remedied by the contractor. No warranty provisions shall be voided due to plant environment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 The Contractor, for purposes of the Ontario Occupational Health and Safety Act, shall be designated as the Constructor for this project and shall assume all of the responsibilities of the Constructor as set out in that Act and its regulations. The foregoing shall apply notwithstanding that the successful bidder has been referred to as the 'Contractor' in this and any other related document. The Contractor shall comply with the following:

.1 The Contractor acknowledges that the Contractor has read and understood the Occupational Health and Safety Act (R.S.O. 1990, C-0.1, as amended).

.2 The Contractor covenants and agrees to observe strictly and faithfully the provisions of the said Occupational Health and Safety Act and all regulations and rules promulgated thereunder.

.3 The Contractor agrees to indemnify and save the Owner harmless for damages or fines arising from any breach or breaches of the said Occupational Health and Safety Act.

.4 The Contractor agrees to assume full responsibility for the enforcement of the said Occupational Health and Safety Act to ensure compliance therewith.

.5 The Contractor further acknowledges and agrees that any breach or breaches of the Occupational Health and Safety Act whether by the Contractor or any of the Contractor's sub-contractors may result in the immediate termination of this contract.

.6 The Contractor shall allow access to the Work site on demand to representatives of the Owner to inspect Work sites to ensure compliance with the Occupational Health and Safety Act.

.7 The Contractor agrees that any damages or fines that may be assessed against the Owner by reason of a breach or breaches of the Occupational Health and Safety Act by the Contractor or any of the Contractor's sub-contractors will entitle the Owner to set-off the damages so assessed against any monies that the Owner may from time to time owe the Contractor under this contract or under any other contract whatsoever.

.8 Ontario Regulation 213/91 (Construction Projects) and the following regulations under the Act and standards may also affect execution of the terms of the contract:

.1 Ontario Regulation

.1 Confined Spaces Requirement in the Regulation for Construction Projects (Reg 628/05)

.2 Confined Spaces (Reg 632/05)

.3 Control of Exposure to Biological or Chemical Agents (Reg 833)

.4 Critical Injury - Defined (Reg 834)

.5 Designated Substance - Asbestos on Construction Projects (Reg 278/05)

.6 Designated Substance - Vinyl Chloride (Reg 846)

.7 Roll-Over Protective Structures (Reg 856)

.8 Workplace Hazardous Materials Information System - WHMIS (Reg 860)

.9 First Aid Requirements (Reg 1101)

.2 Canadian Standards Association (CSA)

.1 CAN/CSA-Z259.1 Body Belts and Saddles for Work Positioning and Travel Restraint.

.2 CAN/CSA-Z259.10 Full body Harnesses.

.3 CAN/CSA-Z259.11 Energy Absorbers and Lanyards.

.4 CAN/CSA-Z259.2.1 Fall Arresters, Vertical Lifelines and Rails.
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.5 FCC No. 301 Standard for Construction Operations.

.6 CSA Z275.2 Occupational Safety Code for Diving Operations.

.7 CSA Z275.4 Competency Standard for Divers Operations.

.8 CSA Z797, Code of Practice for Access Scaffold.

.2 The Contractor shall provide a list of all controlled hazardous materials or products containing hazardous materials, all physical agents or devices or equipment producing or omitting physical agent and any substance, compound, product or physical agent that is deemed to be or contains a designated substance in accordance with the Workplace Hazardous Materials Information System (WHMIS) as defined under the Ontario Occupational Health and Safety Act and shall provide appropriate Material Health and Safety Data Sheets for these substances used for the performance of the required Work, all prior to the performance of the Work.

.3 Where hazardous materials, physical agents and/or designated substances are used in the performance of the required Work, the successful Contractor shall ensure that the requirements of the Ontario Occupational Health and Safety Act and associated regulations are complied with.

.4 The Owner reserves the right to cancel any contract for non-compliance with the terms set out herein, health and safety regulations, the Environmental Protection Act, associated regulations, and other applicable legislation.

.5 The Contractor shall perform the Work so as to cause the public the least inconvenience possible. In particular, the Contractor shall not obstruct any street, thoroughfare, or foot walk longer or to a greater extent than necessary.

.6 The Contractor shall take all reasonable precaution necessary to ensure the safety of the Workers and the general public, particularly children who may play in the area of Work.

1.2 SUBMITTALS

.1 Submit project specific Health and Safety Plan within **two (2) weeks** after date of Contract Award.

.2 Prepare a detailed project specific Health and Safety Plan that shall identify, evaluate and control job specific hazards and the necessary control measures to be implemented for managing hazards. The project specific Health and Safety Plan must address the items as outlined following:

.1 Engineering and administrative demonstrative controls (work-practices and procedures) to be implemented for managing identified and potential hazards, and comply with applicable federal and provincial legislation and more stringent requirements that have been specified in these specifications, including:

.1 Define work tasks and objectives of site activities/operations and the logistics and resources required to reach these tasks and objectives.

.2 Establish personnel requirements for implementing the plan, and

.3 A personal protected equipment (PPE) Program which shall detail PPE:

.1 Selection criteria based on site hazards.

.2 Use, maintenance, inspection and storage requirements and procedures.

.3 Decontamination and disposal procedures.

.4 Inspection procedures prior to during and after use, and other appropriate medical considerations.

.5 Limitations during temperature extremes, heat stress and other appropriate medical consideration

.4 An organizational structure which shall establish the specific chain of command and specify the overall responsibilities of contractor's employees at the work site.

.1 Project specific safety hazard assessment and hazard analysis for each site task and operation along with the identified mitigating factors.

.2 CAD 7 report from the Workplace Safety & Insurance Board outlining the accident history for the last 3 years, or a summary of accident history for the last 3 years.

.3 Construction Safety Checklists after completion.

.4 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.

.5 Material Safety Data Sheets (MSDS) and documentation on the safe handling procedures for any "hazardous" materials or chemicals that the Contractor, sub-contractors, or representatives, plan to bring on site.

.6 Submit, and post at the Work site, the emergency numbers for police, fire and ambulance for the locale of the Work, as well as the names and after-hours numbers for key site personnel related to health, safety or security of the site.

.7 All necessary health and safety permit, notifications and TSSA license certifications.

.3 Personnel training requirements including as follows:

.1 Names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.

.2 Work practices by which personnel can minimize risks from hazards, safe use of engineering controls and equipment on site including recognition of symptoms

and signs, which might indicate overexposure to hazards, and elements of site-specific Health and Safety Plan.

.3 Site control measures to be employed at site including site map, site work zones, use of 'buddy system', site communications including site security, alerting means for emergencies, standard operating procedures or safe work practices, and identification of nearest medical assistance.

.4 Emergency response requirements addressing: Pre-emergency planning, personnel roles, lines of authority and communication, emergency recognition and prevention, safe distances and places of refuge, site security and control, evacuation routes and procedures, emergency medical treatment and first aid, emergency alerting and response procedures, critique of response and follow-up, emergency equipment, site topography, layout, prevailing weather conditions, and procedures for reporting incidents to local, provincial, or federal agencies.

.5 Written respiratory protection program for applicable project activities.

.6 Procedures for dealing with heat and/or cold stress.

.7 Confined space entry procedures.

.8 Spill containment program if drummed waste material is generated, excavated, stored, or managed on site.

1.3 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

.2 Submit hazard assessment report to Engineer.

1.4 MEETINGS

.1 Attend health and safety preconstruction meeting.

.2 Arrange for "toolbox" safety meetings and submit reports.

1.5 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Program based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Program must address project specifications.

.2 Correct deficiencies and re submit Health and Safety Program when so requested by Engineer.

1.6 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial, and local statutes, regulations, and ordinances, and with site specific Health and Safety Program.

1.7 UNFORSEEN HAZARDS

.1 Should any unforeseen or peculiar safety related factor, hazard, or condition become evident during performance of Work, immediately stop work and follow procedures in place for employee's right to refuse work in accordance with the OH&S Legislation. Advise Engineer verbally and in writing.

1.8 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by Engineer or designated safety inspector.

.2 Provide Engineer with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Be aware that Engineer may stop Work if non-compliance of health and safety regulations is not corrected.

1.9 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

.2 Stop Work when necessary or advisable for reasons of health and safety.

.3 Be aware that Engineer or designated safety inspector may stop Work when deemed necessary or advisable for reasons of health and safety.

1.10 OVERLOADING

.1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

1.11 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province and authority having jurisdiction, and in consultation with the Engineer and the Owner.

1.12 SAFETY EQUIPMENT

.1 Ensure workers on the jobsite use personal protective equipment appropriate to the hazards identified in the project specific Health and Safety Plan and those workers are trained in the proper care, use, and maintenance of such equipment.

.2 PPE selections shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, task-specific conditions, duration and hazards and potential hazards identified on site.

.3 Provide all workers and up to five (5) visitors to the site with proper hearing protection. Workers and visitors shall not be exposed to noise levels greater than 85 dB (A) over an

eight hour shift without proper hearing protection, in accordance with the Hearing Conservation Program.

.4 Provide all workers and up to five (5) visitors to the site with CSA approved eye protection sufficient to act as a protective barrier between the eye and airborne contaminants, hazardous materials and physical hazard.

.5 Provide workers and up to five (5) visitors to the site with CSA approved hard hats meeting the CSA Z94.1.

.6 Provide high visibility apparel as defined in Occupational Health and Safety Regulations and CSA approved safety boots meeting CSA Z195.

.7 Provide other personal protective equipment, as may be required, depending on duties being performed such as gas detection equipment for explosive or toxic gases or oxygen deficiency, safety belts, ropes, etc., are to be made available to the inspection staff.

.8 Provide and maintain a suitable detection meter. Use this meter continuously. Calibrate the meter to sound an alarm at a preset warning level.

.9 Metering for Toxic and /or Combustible Gases. And Oxygen Deficiency

.1 Supply and maintain portable combustible gas detection meter, MSA Passport Personal 4-in-1 Alarm Kit Gas Monitor including battery charger, or approved equal, to continuously monitor for toxic and combustible gases, atmospheric hazards, and oxygen deficiency in the surrounding atmosphere. Set meter to sound alarm at a preset warning level. Recharge meter batteries after each 8 hours maximum period of use.

.2 Provide a minimum of two (2) meters for each hazardous location in which work is executed.

.10 Provide and maintain suitable fire fighting equipment when working in the designated hazardous locations. Train personnel in the use of fire fighting equipment.

1.13 HEAVY EQUIPMENT

.1 Ensure mobile equipment used on jobsite is of the type specified in OH&S Act and Regulations fitted with a Roll Over Protective (ROP) Structure and Falling Object Protective (FOP) Structure.

.2 Obtain written clearance from the power utility where equipment is used in close proximity to (within 5.5 metres) overhead or underground power lines.

.3 Equip cranes with:

.1 A mechanism which will effectively prevent the hook assembly from running into the top boom pulley.

.2 A legible load chart.

.3 A maintenance log book.

1.14 FALSEWORK

.1 Design and construct falsework and formwork in accordance with CSA S269.1.

1.15 SCAFFOLDING

.1 Design, erect, inspect, operate, modify, and dismantle scaffolding in accordance with CSA Z797, the OH&S Act and Regulations, and the scaffold manufacturer's written instructions.

.2 Provide trained and certified Competent Scaffold Erectors for all scaffold erection, modification and dismantling.

.3 Conduct and document daily inspections of scaffolding by trained and certified Competent Scaffold Inspectors or Erectors.

.4 Provide a scaffold tagging system as described in CSA Z797.

.5 Ensure that all industry best practices for safe scaffold usage, including fall protection, proper loading, safe access, electrical hazards, exit door management and other concerns are strictly adhered to.

1.16 WORKING AT HEIGHTS

.1 Ensure that fall restraint or fall arrest devices are used by all workers working at elevations greater than 3.05 meters above grade or floor level in accordance with CSA Z259, where alternate fall protection systems are not provided in accordance with Occupational Health and Safety Act and Regulations.

.2 All workers performing work at height and who will be required to utilize a fall arrest system must be trained in a fall protection program certified by the WHSCC.

.3 Prior to working at height workers shall be instructed in a Contractor SWP for working at height and associated rescue plan for working at height developed specific to the work, locations and risks.

1.17 WORK IN CONFINED SPACE

.1 Hazardous Locations are to be classified and managed as Confined Spaces (as defined by O. Reg. 628/05 and 632/05, OHSA). All work and entry into the identified Confined Spaces is to be done in accordance with the Regulations (O. Reg. 628/05 and 632/05).

.2 Contractor is responsible for all confined space entry permitting, assessment, entry, control, and rescue planning in accordance with the Regulation.

.3 Contractor shall maintain all appropriate documentation required under the Regulation (including copy of an "Entry Permit" for each entry into the confined space) and provide daily copies to the Engineer.

.4 All work areas suspected of containing explosive or toxic gases or that are oxygen deficient must be routinely tested for presence of same before any work is done. Make

safe any work area that is found hazardous before any work may proceed, in accordance with safe practice and applicable statutes.

.5 Provide appropriate safety equipment and confined space entry equipment including but not limited to ropes, safety belts, combustible/hazardous gas and oxygen depletion meter for the use of the resident inspection staff. Provide labour to assist Engineer when entry is required to manholes or other areas, which may be hazardous. Engineer is not permitted to enter such areas alone.

.6 Ensure that all personnel engaged in confined space work or work in hazardous locations that require the use of respiratory equipment, comply with the requirements of the Ministry of Labour and must be clean shaven.

1.18 HAZARDOUS MATERIALS

.1 Post warning signs at location where hazardous materials are stored, and install protective barriers, instruct personnel in proper safety procedures.

.2 Only non-sparking tools may be used in potentially explosive areas.

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

.4 The Contractor shall inform the Owner of the location of these materials and shall ensure that these materials are not kept stored or used on site without the Owner's prior consent or approval.

1.19 EXPLOSION-PROOF CONSTRUCTION

.1 Certain areas may be designated on the Drawings as "explosion proof", "hazardous", or may be classified under Section 18 of OESC CSA C22.1. Where areas have such designation, provide explosion proof electrical equipment that meets the requirements of OESC CSA C22.1, Section 18 and NFPA 820 regulations.

.2 In hazardous areas as defined above, provide intrinsically safe mechanical devices and equipment such as, but not limited to non sparking aluminum wheels for fans, pneumatic operators for dampers and aluminum clappers for check valves on pipelines conveying gaseous fuels.

1.20 FIRE PROTECTION

.1 Combustibles shall not be introduced into the plant and environs until required fire protection is in service.

.2 Contractor shall place all new fire protection in service as soon as possible and notify the Engineer upon completion of all new fire protection services.

.3 Contractor shall provide adequate supplementary fire protection facilities including but not limited to hand-operated 15 to 20 pound multi-purpose dry chemical extinguishers

adequately distributed in the plant. Temporary hose lines shall be connected in areas where construction is in progress until the permanent fire protection can be placed in service. Hydrant hose connections and other fire fighting equipment shall not be blocked by construction equipment and must be readily accessible at all times.

.4 Contractor shall dispose of all combustible rubbish promptly and safely, particularly material subject to spontaneous ignition such as oily waste and paint rags.

.5 Potential ignition sources shall be controlled and monitored as necessary by Contractor, to prevent fires.

.6 Hot work, including but not limited to operations involving open flames or producing heat and/or sparks, such as brazing, cutting, grinding, soldering, and torching, shall be minimized. If there is a practical and safer way to do the work without hot work, the alternative method shall be used.

1.21 SITE CONDITIONS

.1 Work at site may involve contact with:

.1 Sodium Hypochlorite
.2 Aluminum Sulphate
.3 Ferrie Chloride
.4 Hydrofluosilicic Acid
.5 Sodium Bisulphite
.6 Polyelectrolite
.7 Diesel Fuel
.8 Methane gas
.9 Hydrogen sulfide gas (H2S)
.10 High Voltage Electricity

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting and patching means acceptance of existing conditions.

.4 Provide temporary structural supports to ensure structural integrity of surroundings.

.5 Provide devices and methods to protect other portions of project from damage.

.6 Provide protection from elements for areas which may be exposed by uncovering work.

.7 Maintain excavations free of water.

1.2 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the specifications, 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.

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

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Engineer to require removal and re-installation at no increase in Contract Amount.

1.3 WORKMANSHIP

.1 General:

.1 Execute work by workers experienced and skilled in the respective duties for which they are employed. Notify Engineer immediately if required Work is such as to make it impractical to produce required results.

.2 Do not employ any unfit person or anyone unskilled in their required duties. Engineer reserves the right to require the dismissal from the site, of workers deemed incompetent, careless, insubordinate or otherwise objectionable.

.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with Engineer, whose decision is final.

.2 Co-ordination:

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for co-ordination and placement of openings, sleeves and accessories.

.3 Protection of Work in Progress:

.1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by Engineer, at no increase in Contract Amount.

.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 Engineer.

.4 Remedial Work:

.1 Perform remedial work required to repair or replace the parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with the materials affected. Perform in a manner to neither damage nor endanger any portion of Work.

.5 Location of Fixtures:

.1 Consider the location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Engineer of a conflicting installation. Install as directed.

.6 Concealment:

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform Engineer if there is a contradictory situation. Install as directed by Engineer.

1.4 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with a minimum of disturbance to Work.

.2 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authority having jurisdiction, stake and record location of capped service.

Part 2 Products

Not Used.

Part 3 Execution

Not Used.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Be responsible for the performance and commissioning of all equipment supplied under this Contract. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.

.2 In consultation with the Owner, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all process, mechanical, electrical, instrumentation and controls, and SCADA systems.

1.2 PERFORMANCE VERIFICATION OBJECTIVE

.1 Period of time of Performance Verification for acceptance of continuous automatic operation with all systems operating continuously 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 shall be:

.1 **Two weeks**

.2 Successful completion of the Performance Verification commissioning is a requirement of Substantial Completion of the project.

1.3 DEFINITIONS

.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 shall conduct inspections of all components and sub-components and shall 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 shall obtain completed Equipment Installation Certification Forms for each specified piece of equipment and shall submit these to Owner for review. Once Owner 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 shall be placed on the equipment designating that the Pre-Start-Up Phase for that particular system is complete.

.2 **Start-Up:** Once each piece of equipment within a defined system carries a "Ready-to-Start" tag, then that individual system shall be started and tested. Both "Dry-Run" and "Wet-Run" tests are required. Contractor shall conduct performance tests of all equipment in conjunction with the manufacturers' representatives as required by the Contract Documents and under the witness of Owner. Deficiencies that are uncovered shall be corrected and retesting shall be conducted as required. Start-Up Completion Certificates shall be prepared by Contractor certifying that the equipment or system is

complete, successfully tested, started and ready for commissioning and continuous operation.

.3 **Commissioning:** Commissioning consists of placing all the various systems in Work into continuous operation in an orderly manner. Contractor is responsible for the commissioning activities and shall have equipment manufacturer representatives at the site, as well as qualified mechanical, electrical, control and instrumentation personnel. Contractor may be assisted by Owner relative to process considerations and by Owner's operations and maintenance staff. Commissioning is considered to be complete when all systems have been operating continuously without fault and in accordance with the specified performance requirements.

1.4 COMMISSIONING (CX) GENERAL

.1 Acronyms:

.1 AFD - Alternate Forms of Delivery, service provider.
.2 BMM - Building Management Manual.
.3 Cx - Commissioning.
.4 EMCS - Energy Monitoring and Control Systems.
.5 O&M - Operation and Maintenance.
.6 PI - Product Information.
.7 PV - Performance Verification.

.2 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.

.1 Objectives:

.1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
.2 Ensure appropriate documentation is compiled into the O&M Manuals.
.3 Effectively train staff.

.3 Contractor is the lead in the Cx process, operating equipment and systems, troubleshooting and making adjustments as required.

.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
.3 Report conflicts between requirements of this section and other sections to Engineer before start-up and obtain clarification.

.1 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

.4 Design Criteria: as per client's requirements or determined by designer. To meet functional and operational requirements.

1.5 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule.

.2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

.1 Approval of Cx reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

1.6 QUALITY CONTROL

.1 When specified in individual Sections of Contract Documents, require equipment manufacturer or supplier is to provide authorized technical representative(s) with testing, start-up and commissioning experience on their equipment. The Testing and Commissioning Manager is to ensure that the necessary technical individuals are present for each system as required to facilitate this process and minimize delays.

.2 Testing:

.1 Provide all required testing equipment and ancillary equipment to verify specified performance.

.2 Calibrate all test equipment to plus or minus two percent (2%) of actual value at full scale.

.3 Employ recognized, industry standard calibration procedures or as specified in individual Sections.

.4 Submit calibration plans and results to Owner.

.3 Attend and participate in Pre-start-up, Start-up and Commissioning workshops with Owner.

1.7 SAFETY

.1 Ensure all requisite safety equipment, devices, detectors, materials and procedures are in place, tested and operational before commencing.

.2 Conform to requirements of all regulatory authorities having jurisdiction.

.3 Maintain communications with fire, police, environmental and health authorities.

1.8 ENVIRONMENTAL PROTECTION

.1 Comply with all requirements of federal, provincial and local jurisdictions having authority.

1.9 MANUFACTURER'S INVOLVEMENT

.1 Contractor's Cx Agents to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

.2 Factory testing: manufacturer to:

.1 Coordinate time and location of testing.

.2 Provide testing documentation for approval by Engineer.

.3 Arrange for Engineer to witness tests.

.4 Obtain written approval of test results and documentation from Engineer before delivery to site.

.3 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Engineer. Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.1 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.4 Integrity of warranties:

.1 Use manufacturers' trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

.5 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 To report results in clear, concise, logical manner.

1.10 PRE-START UP

.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.

.2 Identify all pieces of equipment by Tag Numbers.

.3 Remove all scaffolding, debris, planks tools and other construction-related material.

.4 Remove all sand, silt, dirt and debris from tanks, channels, chambers, instrumentation and control panels and electrical panels and vacuum clean.

.5 Clean all surfaces of tanks and conduits, including walls, roofs, floors and columns with high pressure water jets or as specified in individual Sections.

.6 Clean interior of all pipes and fluid-carrying equipment, including pumps and inspect with Owner present.

.7 Provide photographic evidence (electronic copy and hardcopy) and/or digital video survey of pipes along with written report to Owner for approval.

.8 Conduct leakage and pressure tests in accordance with individual Sections.

.9 Conduct disinfection procedures in accordance with requirements of individual Sections.

.10 Provide Checkout Tag for each piece of equipment.

.11 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.

.12 Equipment Manufacturer's Representatives to inspect equipment in accordance with applicable individual Sections. Certify equipment has been properly installed and is ready to start.

.13 Contractor to submit Equipment Checkout Listing to Owner. 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).

.14 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.

.15 Request, in writing, a Pre-Start-Up Inspection by Owner. Once Owner 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.

.16 Provide Operating and Maintenance Manuals as required by individual Sections.

1.11 START-UP

.1 Conduct workshop with Owner 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 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 systems' 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.

.2 Develop Owner Training plan and implement.

.3 Conduct Dry Run Tests for all equipment, witnessed by Owner.

.4 Conduct Wet Run Tests for all equipment, witnessed by Owner.

.5 Correct any deficiencies uncovered during testing.

.6 Provide Pre-Commissioning Certification Form.

1.12 COMMISSIONING

.1 Assemble Contractor's commissioning team to respond to requests for assistance by Owner. Team to consist of representatives of Contractor and Contractor's mechanical, electrical and instrumentation staff or subcontractors, as appropriate.

.2 Contractor's representative and commissioning team to be at site during normal working hours for entire commissioning period. 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 and shall be available 8 hours per day, 5 days per week, and within four (4) hours' notice at all times.

.3 Remove and clean or replace as required all permanent and temporary filters and strainers in pipeline systems; replace HVAC filters; dewater and clean sumps and leave process systems clean and filled with clean water, unless otherwise directed by Owner.

.4 Commission Work in stages based on 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

.5 Commissioning to be generally conducted in Local / Manual mode first, followed by Remote / Manual mode and thereafter Remote / Auto mode.

.6 Period of time for continuous automatic operation for acceptance of commissioning is minimum 336 hours (14 days) per device with all systems operating continuously 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.

.7 Failure of any part of Work during the period of continuous automatic operation will require restart of that portion or system of Work, following rectification of the fault or failure.

.8 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 shall be paid by Contractor.

.9 The Commissioning Period is that period of time required to put the Work into continuous operation, to the satisfaction of Owner.

.10 Procedures:

.1 Give Owner minimum 48 hours prior notice before commencing commissioning procedures.

.2 Commission Work in an orderly fashion, system by system, where system is defined as an integral operating entity or loop.

.3 Make adjustments to equipment and other works, as necessary to place Work into operation.

.4 Trial operation:

.1 Trial operate all units.

.2 Check mechanical operation.

.3 Check for overload and undue vibration.

.4 Make necessary adjustments.

.5 Initial operation:

.1 Operate pumping units at design load.

.2 Check operation for alignment, clearance and rigidity.

.3 Make necessary adjustments.

.6 Alignments:

.1 Break open couplings between drivers and pumps after run-in period.

.2 Check alignments.

.7 Calibrate instrument primary elements, such as flow and pressure transmitters.

.8 Tune control loops to optimum performances by adjusting the action of pneumatic controllers.

.9 Make final adjustments to the setpoints of field mounted pressure, level and temperature switches.

1.13 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within

the non-functional system, including related systems as deemed required by Engineer, to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

.3 Report problems, faults or defects affecting Cx to Engineer in writing. Stop Cx until problems are rectified. Proceed with written approval from Engineer.

1.14 TEST RESULTS

.1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

Part 2 Products

.1 Not used

Part 3 Execution

.1 Not Used

END OF SECTION

Part 1 General

1.1 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.

1.2 GENERAL

.1 Prepare two (2) copies of documentation including as-constructed shop drawings to instruct Owner's operations and maintenance staff in the operation and associated maintenance of each piece of equipment and system as supplied and installed.

.2 Submit a skeleton of the O & M Manual, including table of contents, section tabs, scale mock-up of printing proposed for the binders, sample of proposed record drawing storage mechanism, and O & M material from the equipment supplier to the Engineer for approval for each individual process system during the respective pre-startup period. No payment over 70% of the Contract value for that particular individual process system will be made until this is received.

.3 Submit the completed O & M Manuals before 90% of the work is approved for payment. No payment for any work will be made over 90% of the Contract value of the overall project until completed O & M Manuals are received and accepted as satisfactory.

1.3 BINDERS

.1 Provide the material in a black expanding catalogue binder. Binders to be suitably labelled on spine and cover. The catalogue binder shall be Casemade Catalogue Binder P5400 as manufactured by Acco Canada Inc. or approved alternative.

.2 **Contractor to supply a sample of the binder with spine and cover labelling for Engineer and Owner approval prior to submission of final O & M Manuals.**

1.4 CONTENTS

.1 Arrange the material in volumes as described below. Provide a separate binder for each volume unless directed otherwise by Engineer. Where more than one (1) binder is required to accommodate the documentation for a volume, increase or decrease the number of volumes and renumber as necessary:

Volume 1 - Mechanical Operations and Maintenance

Volume 2 - Electrical and Instrumentation Operations

.2 Permanently number each set.

.3 Letter the spine of the binder with the full identification title of the project and the front face with the following on the respective binders:

.1 Full identification title of the project

.2 Volume Number

.3 Volume Title

.4 City name

.5 Number of Sets (i.e., 1 of 3)

.4 Arrange the binders according to the Construction Specifications Institute MASTERFORMAT - Master List of Sections, Titles and Numbers, utilizing laminated mylar plastic divider tabs, colour coded according to section. Markings on the tabs are to be type written. Tab colours are to be as follows:

.1 Division - white

.2 Sections - orange

.3 Subsections - yellow

.5 Make up each binder as follows:

.1 Tab: Table of Contents - details the titles of various divisions of the manual in the binder.

.2 Tab: Introduction to manual - written explanation of the layout of the manual and intended use.

.6 Include separately the following:

.1 Consultant: name, address, telephone, name of Project Manager.

.2 Contractor: name, address, telephone, name of Project Manager.

.3 Major Sub-Contractors: name, address, telephone of sub-contractors included in that binder.

.7 Provide the following for each respective discipline:

.1 Tab: Division number xx:

.2 Index - information in that division in order of appearance in the specification.

.3 List of sub-contractors and suppliers - name, address, and telephone.

.4 Specification section cross-reference.

.5 Drawing List.

.8 Organize the various applicable sections under separate divider tabs labelled division/number as required by the project.

.9 Provide the information given below, where applicable, 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, using a non fading marker, 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; characteristic 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.

.4 Troubleshooting data.

.5 Preventative maintenance program complete with:

.1 Suggested check list sheets.

.2 List of points to be greased or oiled.

.3 Recommended type, grade and temperature range of lubricants.

.4 List of wear points to be inspected and/or adjusted regularly.

.5 Suggested schedule for lubrication and inspection

.6 Schematic, single line, and wiring diagrams.

.7 Valve tag list.

.8 Recommended spare parts list.

.9 Certification, guarantee, warranty.

.10 Service representatives: Name, address and telephone number.

.11 Suppliers for replacement parts: Name, address, and telephone numbers.

.12 Test results: Witness testing and commissioning and provide reports.

.13 Test data for piping systems (degreasing, flushing, disinfection).

.14 Hydrostatic or air tests performance.

.15 Equipment alignment certificates.

.16 Balancing data for air and water systems.

.17 Inspection approval certificates for all types of systems; plumbing and piping, hot air and ventilating, electrical supervisory, etc.

.10 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 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 MASTERFORMAT. Identity any material located in the file cabinet as such in the appropriate location in the binders.

.11 At Engineer's discretion, provide the information in plastic map pockets in appropriate sections in the binders.

Part 2 Products

.1 Not Used

Part 3 Execution

.1 Not Used

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Specific requirements for maintenance materials, tools and spare parts are specified in individual specification sections.

.2 Supply special tools, wrenches, and accessories that are required for removing worn parts, making adjustments, and carrying out maintenance works.

.3 Record the maintenance materials special tools and spare parts received on the Spare Parts Tracking Form that is appended to this specification. The Spare Parts Tracking Form shall be submitted monthly with the spare parts at a Project Construction Meeting.

.4 Deliver maintenance materials, special tools and spare parts in designated area as directed by Engineer.

.5 Prepare lists of maintenance materials special tools and spare parts for inclusion in operations and maintenance manuals.

1.2 MAINTENANCE MATERIALS

.1 Deliver specified items packaged to prevent damage.

.2 Identify, on carton or package, colour, room number, system or area, as applicable, where items are to be used.

1.3 SPECIAL TOOLS

.1 Assemble special tools as specified.

.2 Include following:

- .1 Identification tag reference.
- .2 Identification of equipment or system for which tools are applicable.

.3 Instruction on intended use of tool.

.4 Identify special tools to indicate equipment or system for which tools are intended.

1.4 SPARE PARTS

.1 Assemble spare parts as specified.

.2 Include the following:

- .1 Part number.
- .2 Identification of equipment or system for which parts are applicable.
- .3 Installation instructions as applicable.
- .4 Name and address of nearest supplier.

.3 Identify spare parts to indicate equipment or system for which parts are applicable.

Part 2 Products

.1 Not Used

Part 3 Execution

.1 Not Used

END OF SECTION

Part 1 General

1.1 SCOPE

.1 This section contains requirements for training the plant operating staff, by persons retained by the Equipment Supplier in coordination with General Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

.2 Commissioning will not be approved to commence until the training requirements have been met and approved by the Owner.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of final substantial performance.

.2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.

.3 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:

Item	Equipment	Duration
.1	Electrical Systems	4 hours
.2	Controls and Instrumentation	4 hours
.3	Mechanical / HVAC Systems	4 hours

1.3 QUALITY ASSURANCE

.1 Where required by the detailed specifications, provide on-the-job training of the plant operating staff. The training sessions shall be conducted by qualified, experienced (two (2) years minimum), factory-trained representatives of the various equipment manufacturers. Training shall include instruction of operating personnel in equipment operation and preventive maintenance and instruct plant mechanics, electricians, and electronics technicians in normal maintenance up to major repair.

1.4 SUBMITTALS

.1 The following information shall be submitted to the Engineer. Due to phased testing and start-up activities, separate submittals can be prepared for equipment items or systems. The material shall be reviewed and accepted by the Engineer no later than three (3) weeks prior to delivery of the training.

.1 Lesson plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.

.2 Date, time, and subject of each training session and identity and qualifications of individuals to be conducting the training.

.3 Training schedule. Concurrent classes will not be allowed.

.4 Signed-off Owner 'On the Job Training Attendance Sheet'. This must be submitted after each completed training session and also included in the training manual.

.5 Resume of trainer(s).

Part 2 Products

2.1 GENERAL

.1 Conduct training sessions for the operation and maintenance personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Vendor operation and maintenance manuals, as defined in Specifications, shall be available to the owner's personnel at least 30 days prior to the date scheduled for the individual training session.

2.2 LOCATION

.1 Field training sessions shall take place at the Kenora WWTP.

2.3 LESSON PLANS

.1 Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject. One (1) complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall be the property of the owner and shall be suitably bound for proper organization and easy reproduction. Furnish twelve (12) copies of necessary training manuals, handouts, visual aids and reference materials at least one (1) week prior to each training session.

2.4 FORMAT AND CONTENT

.1 Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, a training session shall cover the following topics for each item of equipment or system:

.1 Familiarization.

.2 Safety.

.3 Operation.

.4 Troubleshooting.

.5 Preventive maintenance.

.6 Corrective maintenance.

.7 Parts.

.8 Local representatives.

.9 Operation and maintenance manuals.

2.5 VIDEO RECORDING

.1 The Owner may record themselves or retain the services of a commercial video recording service to record each training session. After recording, the material may be edited and supplemented with professionally produced graphics to provide a permanent record. The Contractor will advise all manufacturers providing training sessions that the material may be recorded.

Part 3 Execution

3.1 GENERAL REQUIREMENTS

.1 Training shall be conducted in a separate visit from the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. Arrange to have the training conducted on non-consecutive days, with no more than four (4) hours of classes scheduled for any one (1) day.

3.2 OPERATIONS AND MAINTENANCE CLASSROOM TRAINING

.1 As a minimum, classroom equipment training for operations and maintenance personnel will include:

.1 Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.

.2 Purpose and plant function of the equipment.

.3 A working knowledge of the operating theory of the equipment.

.4 Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.

.5 Identify and discuss safety items and procedures.

.6 Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.

.7 Operator detection, without test instruments, of specific equipment trouble symptoms.

.8 Required equipment exercise procedures and intervals.

.9 Routine disassembly and assembly of equipment if applicable (as judged by the Owner on a case-by-case basis) for purposes such as operator inspection of equipment.

.10 Normal and major repair procedures.

.11 Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.

.12 Routine and long-term calibration procedures.

3.3 OPERATIONS AND MAINTENANCE PERSONNEL HANDS-ON TRAINING

.1 As a minimum, hands-on equipment training for operations and maintenance personnel will include:

.1 Identify location of equipment and review the purpose.

.2 Review the equipment function and theory of operation.

.3 Identifying piping and flow options.

.4 Identifying valves and their purpose.

.5 Identifying instrumentation:

.1 Location of primary element.

.2 Location of instrument readout.

.3 Discuss purpose, basic operation, and information interpretation.

.6 Discuss, demonstrate, and perform standard operating procedures and round checks.

.7 Discuss and perform the preventative maintenance activities.

.8 Discuss and perform start-up and shutdown procedures.

.9 Perform the required equipment exercise procedures.

.10 Perform routine disassembly and assembly of equipment if applicable.

.11 Identify and review safety items and perform safety procedures.

.12 Review normal repair procedures.

.13 Perform Owner approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

.14 Review and use equipment manufacturer's manuals in the hands-on training.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 All codes and standards governing the work shall be the current edition, in force at the time of tendering for this Contract:

.1 CSA A23.1, Concrete Materials and Methods of Concrete Construction.

.2 CSA A3000, Cementitious materials compendium.

.3 CSA A266.2, Chemical Admixtures for Concrete.

.2 Do grouting in accordance with the grout supplier's instructions, except where noted otherwise on the Contract Drawings.

Part 2 Products

2.1 MATERIAL

.1 Water and fine aggregates to CSA A23.1.

.2 Cementious materials: CSA A3000, Type GU.

.3 Chemical admixtures: To CSA A266.2

.4 Non - Shrink grout: Pre-mixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents. Compressive strength to be minimum 40 MPa at 28 days:

.1 For general usage:

.1 MasterFlow 100 by BASF Master Builders Solutions.

.2 Or approved alternate.

.5 Bonding agent:

.1 Intralok by W. R. Meadows for normal usage.

.2 Or approved alternate.

.3 Apply bonding agent on existing concrete surface prior to grouting.

2.2 COMPATIBILITY

.1 Ensure that all materials used are compatible. Provide written proof of compatibility.

Part 3 Execution

3.1 WORKMANSHIP

.1 Obtain the Engineer’s approval of the type of grout to be used before placing.

.2 Handle, place, and cure non-shrink grout in accordance with Manufacturer's instructions. Request an inspection by the Engineer before placing grout.

3.2 PREPARATION

.1 Maintain surfaces and ambient air temperature of minimum 10° C for a minimum period of 24 hrs prior to, during, and 72 hrs after application.

.2 If grouting in exposed conditions, provide and maintain temporary weatherproof enclosures during inclement weather, during preparation, grouting and curing.

3.3 MIXING

.1 Mix grout dry and add water to bring mix to the correct consistency in a mechanical rotary mixer.

.2 Mix pre-mixed grout in accordance with the Manufacturer's instructions.

3.4 INSPECTION

.1 Notify the Engineer in writing 24 hrs before commencing grouting operations.

3.5 PLACING

.1 Roughen and clean contact surfaces and thoroughly wet with water prior to grouting.

.2 Prepare grout not earlier than 10 min before use and place in final position within 30 min.

.3 Apply bonding agent on the existing concrete surface prior to receiving new grout benching. The surface preparation of the existing concrete refers to Structural Drawings.

.4 Ram dry pack against suitable back-up blocker.

.5 Grout using procedures in accordance with the Manufacturer's recommendations which will result in 100 % contact over grouted area.

.6 Grout under base plates to be installed to assure full bearing. Remove all air pockets.

.7 Finish and tool grout exposed to view in a workmanlike manner, consistent with the finish of adjacent materials.

.8 Continuously moist cure at temperature above 5° C for 7 days and in accordance with the Manufacturer's recommendations.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This Specification Section specifies the requirements for non-destructive investigations prior to drilling, cutting or coring concrete in existing concrete floors, walls, and ceilings.

.2 This Specification Section applies to, but is not limited to, work performed in the following areas:

.1 All existing concrete structures.

Part 2 Products

2.1 GPR AND X-RAY SCANNING

.1 Employ ground penetrating radar (GPR) scanning system optimized for scanning concrete and evaluating results directly on site.

.2 Employ X-Ray scanning system in the event that GPR is not able to determine the findings in existing concrete floors, walls and ceilings.

.3 Acceptable service providers:

.1 Grafscan.
.2 Canadian Cutting and Coring (Toronto) Limited.
.3 Global GPR Services.

Part 3 Execution

3.1 WORKMANSHIP

.1 When it is required to make new holes in existing concrete for piping, conduit, cables, or equipment, the Contractor shall, in all cases:

.1 Will not drill or cut any surface without prior approval of the Engineer.
.2 Determine the location, if any, of existing concealed rebar, conduit and cables, voids and slab thickness of the area to be drilled or cut and confirm routing/locations with the Engineer.
.3 Coordinate with the Engineer and employ integrated penetrating radar (GPR) scanning of the walls or slabs in the area of the proposed core at no additional cost to the Owner.
.4 In the event that GPR is not able to determine the findings in the existing concrete floors, walls and ceilings, X-Ray shall be applied at no additional cost to the Owner to do the further investigation with the approval and cooperation of the Engineer and the Owner.

.5 The Contractor shall be responsible for appropriate setup and boundary controls, signs, staging, etc. in the working area prior to conducting the structural GPR scan or X-Ray. The Contractor to notify the Engineer and the Owner in writing 48 hrs prior to commencing scanning work.

.6 Carefully perform all cutting in a neat and true fashion, with proper tools and equipment (no jack hammer drilling), to the approval of the Engineer.

.7 Patch surfaces, where required, to exactly match existing finishes using tradesmen, skilled in the particular trade or application worked on, to the approval of the Engineer.

.2 Any damage to existing services, exposed or concealed, caused as a result of the cutting and drilling work by the Contractor shall be repaired and/or replaced to the entire satisfaction of the parties concerned at the Contractor's expense.

.3 Where new pipe or conduits pass through existing construction, core drill the openings to an appropriate size with adequate clearances around the pipes, pipe insulation, or conduits as noted on the Contract Drawings as required for proper sealing.

3.2 CONCRETE INSPECTION METHODOLOGY

.1 Structural concrete inspection employing high frequency GPR or X – Ray suitable for locating rebar, conduit, cables and voids in concrete slabs up to 500 mm thick.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 Note that this is a general Specification and that some of the items herein may not be applicable to this Contract.

1.2 REFERENCE STANDARDS

.1 Conform to the latest edition of the following reference standards:

.1 CSA G40.21, Structural Quality Steels.

.2 ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 CSA S16, Steel Structures for Buildings.

.4 ASTM A325, Specifications for High Strength Steel Bolts Classes 10.9 and 10.9.3 for Structural Steel Joints.

.5 CSA W47.2, Certification of Companies for Fusion Welding of Aluminium.

.6 CSA W59, Welded Steel Construction.

.7 CSA W59.2, Welded Aluminium Construction.

.8 CSA HA Series M, Standards for Aluminium and Aluminium Alloys.

1.3 SUBMITTALS

.1 Submit Shop Drawings in accordance with Specifications. Drawings shall indicate design loads and shall bear the seal and signature of a qualified Professional Engineer registered or licensed in the Province of Ontario.

.2 Clearly indicate profiles, sizes, materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, size and type of fasteners and accessories.

.3 Include Erection Drawings, elevations, and details where applicable.

.4 Indicate any necessary welding using CISC Standard Welding Symbols. Clearly indicate net weld lengths.

Part 2 Products

2.1 MATERIALS

.1 Rolled steel sections and plates: To CAN/CSA G40.21, Grade 350 W.

.2 Stainless steel for general conditions: To be AISI Type 316 as noted on the Contract Drawings. For all stainless steel, a minimum yield strength shall be Fy = 220 MPa.

.3 Bolts: Stainless steel to AISI Type 316, as shown.

.4 Anchor rods/bolts: Steel to ASTM F1554 or stainless steel to AISI Type 316, as shown on the Contract Drawings.

.5 Galvanizing: To ASTM A123, Minimum coating 610 g/m^2.

.6 Aluminum sections and plate: To be anodized aluminum alloy, 6061-T6 to CSA HA Series M.

.7 Shop coat primer: To CGSB 1-GP-40M.

.8 Zinc primer: Zinc-rich, ready mix to CGSB 1-GP-181.

.9 Fastening Devices:

.1 Anchors shall be of the same material or appropriate compatible material as metal to which they are applied.

.2 All other bolts, nuts, screws, and anchors shall be stainless steel 316 unless otherwise noted on the Contract Drawings.

.3 Stainless steel fastening devices to be coated with anti-seizing compound before attaching nut.

2.2 PROTECTIVE COATINGS

.1 Apply 1 shop coat of primer compatible with final paint system defined in Specifications or on the Contract Drawings to metal items, with the exception of galvanized, stainless steel, aluminum or concrete encased items.

.2 Use primer unadulterated, as prepared by the manufacturer. Paint on dry surfaces, free from rust, scale, and grease. Do not paint when temperature is lower than 7° C.

.3 Hot dip galvanized steel items after fabrication where shown or required.

.4 Isolate all aluminum surfaces to be in contact with concrete or steel, with 2 coats of bituminous paint.

2.3 ANCHORS

.1 Anchor Rods/Bolts:

.1 HAS Stainless Steel AISI Type 316 rods, Hilti Products Inc., unless otherwise shown on the Contract Drawings.

.2 Provide a minimum of 150 mm embedment unless otherwise shown on the Contract Drawings.

.2 Chemical Anchor Adhesive:

.1 HIT-HY 200 adhesive for steel dowels and anchor rods/bolts, Hilti Products Inc., unless otherwise shown on the Contract Drawings.

2.4 MISCELLANEOUS STEEL SECTIONS AND PLATES

.1 Install all loose angles or other steel items not specifically noted as part of other trades on this Contract. Miscellaneous shapes to be furnished complete with all anchors, bolts or other fixings necessary to complete the installation.

2.5 GASKET

.1 Gasket: Use gasket materials for air-tightness suitable for the contact surface between ledge plates and access insert panels. Refer to detailed specifications for recommended gasket material. Material designations used in the detailed specification sheets are as follows:

.1 EPDM: ethylene-propylene-diene-terpolymer 70 durometer.

Part 3 Execution

3.1 FABRICATION

.1 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Construct the work free from distortion and defects detrimental to the appearance and performance.

.3 Fabricate items from steel unless specified otherwise.

.4 Use self-tapping shake-proof round headed screws on items requiring assembly by screws or as indicated.

.5 Where possible, fit and shop assemble work, ready for erection.

.6 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

.7 After fabrication, hot-dip galvanize all ferrous metal items unless otherwise specifically noted on the Contract Drawings.

3.2 ERECTION

.1 Erect metal work square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.2 Provide suitable means of anchorage acceptable to the Engineer such as dowels, anchor clips, bar anchors, expansion and adhesive, bolts and shields, and toggles.

.3 Make all field connections with stainless steel bolts AISI Type 316, as per Clause 2.1.5 above.

.4 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

.5 Touch-up rivets, bolts and burnt or scratched surfaces after completion of erection with primer.

.6 Touch-up galvanized surfaces with zinc-rich primer where damaged.

.7 Gratings are to be secured to supports in accordance with the Manufacturer’s instructions. Fasten in line each end of bearing bars to maintain lateral support to beams.

3.3 COLD WORKING AND THERMAL TREATMENT

.1 All cold worked fabricated steel shall be stress relieved following the stress relieving procedures in ASTM A123 prior to galvanizing.

3.4 INSTALLATION

.1 Install metal items as shown on the Contract Drawings, and where appropriate, as per the Manufacturer's recommendations.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Specifications.

.2 Indicate each type of door and frame material, core thickness, reinforcement, location of anchors, and exposed fasteners and finishes.

1.2 REFERENCE STANDARDS

.1 ASTM F476 (2002) – Standard Test Methods for Security of Swinging Door Assemblies.

.2 ANSI/NAAMM HMMA 862-03 – Guide Specifications for Commercial Security Hollow Metal Doors and Frames.

Part 2 Products

2.1 MATERIALS

.1 Sheet Steel:

.1 Commercial grade cold rolled steel conforming to ASTM A653M-96 with ZF275 wiped zinc coating.

.2 Steel minimum thickness as follows:

Frames:	2.0 mm minimum
Spreaders and Anchors:	1.6 mm minimum
Guard Boxes:	0.8 mm minimum
Exterior Doors:	1.6 mm minimum
Door Stiffeners	1.2 mm minimum

.2 Door bumpers: black neoprene.

.3 Insulation: Polyurethane.

.4 Primer: Conform to CGSB 1-GP-181M.

.5 Frame size: all frames to have minimum 51 mm jamb face and minimum172 mm jamb depth.

.6 All dimensions for material to be minimum requirements and door suppliers to design doors and frames to suit strength and operation requirements.

2.2 FABRICATION

.1 Fabricate doors and frames as detailed, to Canadian Steel Door and Frame Manufacturer’s Association, Canadian Manufacturing Specifications for Steel Doors and Frames, except where specified otherwise.

.2 Stiffen exterior doors with continuous vertical steel stiffeners at 150 mm o.c. spot welded to both face sheets.

.3 Insulate exterior doors with polyurethane foam insulation completely filling the cavity.

.4 Provide astragal on active leaf of double doors.

.5 Provide weather caps for all exterior doors.

.6 Cut mitres and joints accurately and weld continuously on inside of frame profile.

.7 Grind welded corners and joints to flat plane, fill with metallic paste filler, and sand to uniform smooth finish.

.8 Provide jamb anchors for fixing at floor, ceiling, and mid-points. Provide opening at base of jambs to allow installation of floor anchorage.

.9 Reinforce head of frames wider than 1200 mm.

.10 Install three bumpers on strike jamb for each single door and two bumpers at head for pairs of doors.

.11 Mortise, reinforce, drill, and tap doors and reinforcements to receive hardware using templates provided by finish hardware supplier.

.12 Touch up doors and frames with primer where galvanized finish is damaged during fabrication.

Part 3 Execution

3.1 INSTALLATION

.1 Set frames plumb, square, level, and at correct elevation.

.2 Secure anchorage and connections to adjacent construction.

.3 Make allowances for deflection of structure to ensure structural loads are not transmitted to the frames.

.4 Brace frame 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.

.5 Co-ordinate grouting of all exterior frames solid to adjacent construction.

.6 Install doors and hardware in accordance with hardware templates and manufacturer’s instructions. Adjust operable parts for correct function.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Finish symbols and abbreviations used throughout these specifications conform to A.N.S.I. standards.

.2 Use U.L.C. listed and labelled hardware for doors with fire ratings.

1.2 SUBMITTALS

.1 Submit hardware schedule in accordance with Specification Section 01330 –Submittals.

.2 Indicate hardware make, model, material, function, and finish.

.3 Submit samples of hardware items, if requested by the Engineer.

1.3 QUALITY ASSURANCE

.1 Hardware schedules shall be prepared by an experienced hardware consultant A.H.C.who is a member of the Door and Hardware Institute, Ontario Chapter.

1.4 DISCREPANCIES

.1 Report any discrepancies between the Drawings and the Specifications to the Engineer prior to supply of hardware.

1.5 DELIVERY AND STORAGE

.1 Store finish hardware in locked, clean, and dry area.

.2 Package each item of hardware, including fastenings, separately or in like groups of hardware and label each package for identification and location.

1.6 WARRANTY

.1 Warrant closes in accordance with the General Conditions, except the period shall be for five years.

.2 Warrant all other hardware in accordance with the General Conditions, except the period shall be for two years.

Part 2 Products

2.1 MATERIALS

.1 Hardware manufacturers, products, and finishes shall conform to the approved Hardware Schedule.

.1 Hinges: Stanley or Hagar.

.2	Panic Sets:	Von Duprin 98 Series.
.3	Lock Cylinders:	Medeco security locks.
.4	Door Closers:	LCN, Hager.
.5	Flush Bolts:	Glynn-Johnson, Hager.
.6	Weatherstripping:	KN Crowder, Hager.
.7	Lock Guards:	Ives, Hager.
.8	Miscellaneous:	Canadian Builders Hardware, Hager.

2.2 KEYING

.1 Keying shall be as follows:

.1 All cylinders shall be construction master keyed as per the client's Security standard.

.2 All cylinders shall be master keyed.

.3 All cylinders shall be keyed alike or differently on keyway as directed by the Owner.

.2 Provide:

.1 Three construction master keys.

.2 Three master keys.

.3 Two keys per lock.

Part 3 Execution

3.1 INSTALLATION

.1 Furnish door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.2 Furnish manufacturer's instructions for proper installation of each hardware component complete with schedule of mounting heights.

3.2 INSPECTION

.1 After installation of all hardware and before building is accepted, the Contractor shall request the hardware supplier to inspect the installation and certify that the hardware is properly installed in accordance with the manufacturer's recommendations. The warranty will begin on the date of Substantial Performance.

3.3 HARDWARE SCHEDULE

.1 Site to confirm the existing opening size for all doors. The following door size and hardware provided are for reference only.

One single door 900 x 2150 Existing Aerobic Digester Control Building

900 x 2150 x 45 HM DR x HM FR

3	Butts	IHTHB953	114 x 101	NRP/SH	C32D
1	Panic Set	98 NLOP			630
1	Door Pull	CBH 390			630
1	Closer	LCN 4040-H-CUSH-SRI P/ARM MOUNT			652
1	Kickplates	200 x 863			C32D
1	Threshold	CT9 x 915			AL
1	Set Weatherstrip	W13 x 5700			AL
1	Door Sweep	W13S x 915			AL
1	Lock Guard	Ives 180			32D

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 All referenced standards in division specification sections shall be to the latest applicable edition including all addenda.

1.2 QUALITY ASSURANCE

.1 Welding materials, fabrication standards and labour qualifications shall meet Provincial Labour Board Regulations. All welders must be licensed by Provincial authorities.

.2 Work performed under Divisions 20, 21, 22, and 23 must be carried out by licensed tradesmen regularly employed and experienced with the type of work being installed under the Contract.

.3 Work performed on pressure piping systems 103 kPa (15 PSI) and greater must be performed by steamfitters / pipefitters licensed by TSSA.

.4 This Contractor shall belong to the Mechanical Contractors Association of the Province the work is being performed in.

.5 Provide all labour, materials, equipment and services required to complete the Work specified in the Contract Documents and as shown on the Contract Drawings.

.6 The work specified in this Section generally includes plumbing, building drainage, piping, heating, cooling and ventilating systems required for the Work.

.7 Provide all accessories and appurtenances as required to ensure complete, operational and energy efficient systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Where required, submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.

.2 Indicate on drawings:

.1 Performance data.

.2 Dimensions, weights and access requirements.

.3 Construction details.

.4 Piping and ductwork connections, locations and sizes.

.5 Mounting arrangements.

.6 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.6 Detailed drawings of seismic control measures.

.4 Alternate product manufacturer's equipment is acceptable upon acceptance of approved equal by Owner/Owner's Representative. Contractor to submit alternate during shop drawing review. Owner/Owner's Representative to review and should alternate not meet parameters of specified product, Owner/Owner's Representative has authority to request specified equipment be provided. Contractor is responsible for accepted equal to meet all specified parameters on drawings and in specifications. Parameters include but are not limited to:

.1 Performance data and characteristics.

.2 Capacities.

.3 Fabrication.

.4 Layout, showing dimensions, including identified field dimensions, and operating and maintenance clearances.

.5 Setting or erection details.

.6 Standards.

.7 Operating weight.

.8 Configuration of unit and its components.

.9 Sound power data.

.10 Control components.

.11 Acoustic and sound power data.

.12 Certification and compliance to applicable codes.

.5 Refer to Section 01 33 00 – Submittal Procedures.

1.4 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

.1 Operation and maintenance manual approved by, and final copies deposited with Owner/Owner's Representative before final inspection.

.2 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.3 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.4 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Balancing and Adjusting for HVAC.

.5 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Owner/Owner’s Representative for approval. Submission of individual data will not be accepted unless directed by Owner/Owner’s Representative.

.2 Make changes as required and re-submit as directed by Owner/Owner’s Representative.

.6 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.7 Site records:

.1 Owner/Owner’s Representative will provide 1 set of reproducible mechanical drawings. Provide sets of prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-Built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Owner/Owner’s Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC, using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.9 Submit copies of as-built drawings for inclusion in final TAB report.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 39 – Project Record Documents.

.2 Furnish spare parts as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One glass for each gauge glass.

.4 One head gasket set for each heat exchanger.

.5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.6 As per specific equipment sections.

.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.6 METRIC CONVERSIONS

.1 All specified units of measurement under this Division are expressed in SI units.

.2 Submit shop drawings and Operation & Maintenance Manuals in SI units.

.3 On all submittals use the same SI units as states in the specifications.

.4 All whole-number inch designations convert to multiples of 25 mm for ductwork.

.5 Pipe size from 2" through to 60", conversion based on CSA standard Z245.1. Pipe size 2" and smaller, conversion based on European ISO standard. Other pipe sizes are U.S. Conversions to the metric system.

NOMINAL PIPE SIZES	
IMPERIAL (Inches)	**METRIC (mm)**
⅛	6
¼	8
⅜	10
½	15
¾	20
1	25
1¼	32
1½	40
2	50
2½	65
3	80
3½	90
4	100
5	125
6	150
8	200
10	250
12	300
14	350

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 and according to manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and handling requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

Not Used.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation of mechanical products and components and in accordance with manufacturer's written instructions.

.2 This project involves building renovations/ modifications. Therefore, careful examination of the site and local conditions will be required to determine the difficulties in carrying out the work indicated. Existing mechanical systems illustrated on drawings shall not be construed as "as-built". Contractor shall notify Consultant of differences between drawings and site prior to final tender for inclusion in any addendum issued.

.3 Contractor shall allow for variations of existing mechanical systems illustrated prior to submitting final price. Extras will not be considered based on differences on site.

.4 Coordinate all new and modification works with all existing systems and all trades including but not limited to the following existing items that are required to remain:

.1 Existing light fixtures, electrical panels, outlets, switches, conduits, emergency lighting and signage.

.2 Existing columns, beams, cross bracing and joists.

.3 Existing control components.

.4 Existing piping, equipment and ductwork.

.5 Owner/Owner's Representative Site Reviews:

.1 Coordination: contractor to coordinate progress site reviews with Owner/Owner's Representative to ensure all work is reviewed before it is concealed in walls, slab or bulkheads. If work is concealed prior to Owner/Owner's Representative's review, Owner/Owner's Representative can request Contractor to disassemble enclosure for review and repair at Contractor's cost.

.2 Progress Milestone Reviews: Contractor to provide minimum 7 days notice for review of following:

.1 Underground piping prior to slab pour.

.2 Ductwork and piping prior to ceiling installation.

.3 Mechanical room equipment installation prior to duct and piping installation.

.3 Substantial Completion: Contractor to provide minimum 7 days notice for substantial review. Following items to be verified as complete by the Contractor before substantial review will be conducted:

.1 All plumbing systems are complete and operational.

.2 All life safety systems are complete and operational including standpipe, sprinkler, fire alarm, detection systems, fire and/or smoke dampers and fire extinguishers.

.3 All HVAC systems are complete and operational to all areas of the building.

.4 All control systems are complete and fully tested.

.5 Any smoke control systems and equipment are complete and under control.

.6 All permitting is complete and forwarded to Owner/Owner's Representative.

.7 All equipment and systems testing are complete, and reports submitted to Owner/Owner's Representative. Refer to Section 23 05 92 - Mechanical Systems Starting and Testing.

.8 Balancing and adjusting of all mechanical systems is complete. Refer to Section 23 05 93 – Balancing and Adjusting for HVAC. Refer to Section 23 05 94 – Pressure Testing of Ducted Air Systems.

.9 Site record drawings are complete and have been submitted to Owner/ Owner's Representative.

.10 O&M Manuals have been submitted to Owner/Owner's Representative for review.

.11 Commissioning is completed as per equipment/ system commissioning requirements.

3.2 PAINTING REPAIRS AND RESTORATION

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4 FIELD QUALITY CONTROL

.1 Site Tests: Conduct tests in accordance with Section 01 45 00 – Quality Control and submit reports as described in PART 1 – ACTION AND INFORMATIONAL SUBMITTALS.

.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 PART 1 – ACTION AND INFORMATIONAL 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.

3.5 SYSTEM START-UP

.1 General: Perform start-up operations in accordance with all Division 23 sections related to start-up, supplemented as specified herein.

3.6 DEMONSTRATION

.1 Owner/Owner’s Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Contractor will record these demonstrations on video tape for future reference.

3.7 TEMPORARY HEAT

.1 Do not use the permanent system for temporary heating purposes without written permission from the Owner/Owner’s Representative.

.2 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged parts before final inspection.

.3 Use of permanent systems for temporary heat shall not modify terms of warranty.

.4 Operate heating systems under conditions which ensure no temporary or permanent damage.

.5 Operate fans at proper resistance with filters installed. Change filters at regular intervals.

.6 Operate systems and equipment with proper safety devices and controls installed and fully operational.

.7 Operate systems only with treated water as specified.

.8 Where supply ventilation systems are used during temporary heating, protect with 60% filters, inspect daily and change every week or more frequently as required. Provide filter media on return and exhaust air outlets. Clean duct systems which have become dirty.

.9 Exhaust systems are not included in approvals for temporary heating ventilation.

.10 When permanent systems are used for temporary heat, provide alarm indicating system failure. Connect alarm to independent alarm company system.

.11 Where pumps are used for temporary heating, replace mechanical seals, regardless of condition, with new mechanical seals.

3.8 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

.2 Protect installed products and components from damage during construction. Repair damage to new or existing products, materials and components during construction.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 TAB means to test, adjust and balance mechanical systems to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Names of personnel it is proposed to perform TAB to be submitted to and approved by the Engineer within 90 days of award of Contract.

.2 Certified to accredited program (i.e. AABC/NEB).

.3 At least 5 years of related industry experience.

.4 Provide documentation confirming qualifications and successful experience in similar types of work.

1.3 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into construction and completion schedule so as to ensure completion before acceptance of Work.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

.3 Coordinate work with Mechanical Contractor and Controls Contractor.

1.6 PRE-TAB REVIEW

.1 Submit the TAB company’s certificate for review by Engineer.

.2 Submit all the applicable report for all proposed procedures which vary from standard to be reviewed by the Engineer.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Divisions 01 and 23.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by the Engineer for verification of TAB reports.

1.9 START OF TAB

.1 Notify the Engineer and the Owner 7 days prior to start of TAB.

.2 Start TAB when building is ready for occupancy on the Mandatory Milestone Performance date, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.
.2 Application of weatherstripping, sealing, caulking.
.3 All pressure, leakage, other tests specified elsewhere in Division 23.
.4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.
.2 Air systems:
.1 Filters in place, clean.
.2 Duct systems clean.
.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
.4 Correct fan rotation.
.5 Fire, smoke, volume control dampers installed and open.
.6 Coil fins combed, clean.
.7 Access doors installed, closed.
.8 Outlets installed, volume control dampers open, air patterns set.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 Ventilation systems: Plus 5%, minus 5%.

.2 Tolerances shall be maintained between interdependent systems (e.g., supply and exhaust assemblies) to ensure that relative pressure relationships remain consistent with design intent. This is critical to satisfy requirements such as those outlined in NFPA 820 for ventilation system performance.

1.11 ACCURACY TOLERANCES

.1 Measured values to be accurate to within ± 2 % of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to the Engineer list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to the Engineer.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB.

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

.3 TAB report shall be submitted to the Engineer for review.

.4 Include a copy of Final TAB report in Section 01 78 23 – Operation & Maintenance Data

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of the Engineer, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.
.2 Details of TAB procedures employed.
.3 Calculations procedures.
.4 Summaries.
.5 TAB Report

1.15 TAB REPORT

.1 Format to be in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.
.2 System schematics.
.3 Include types, serial number, and dates of calibration of instruments in the reports.

.4 Identify on the Drawings the locations and measurement points, tag them properly and reference these tags to the recorded results.

.5 Include all details regarding field adjustments made to equipment by TAB personnel to achieve design performance levels.

1.16 VERIFICATION

.1 Reported results subject to verification by the Engineer.

.2 Provide manpower and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results to be at discretion of the Engineer.

.4 Bear costs to repeat TAB as required to satisfaction of the Engineer.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of the Engineer, replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

.1 TAB to be considered complete when final TAB Report received and approved by Engineer.

1.19 BALANCING OF AIR SYSTEMS

.1 Standard: TAB to be to most stringent of this section or TAB standards of AABC (The Associated Air Balance Council).

.2 Measurements: To include, but not limited to, the following measurements, as appropriate, for the systems, equipment, components or controls: Air velocity, static pressure, flow rate, pressure drop or loss, temperatures, duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.3 Locations of equipment measurements: To include, but not be limited to, the following as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.4 Locations of systems measurements to include, but not be limited to, the following as appropriate: Main duct, main branch, sub-branch, run-out or grille, register or diffuser.

.1 Perform balancing, adjusting and testing with building doors and windows in their normal operation position.

.2 Use the following procedure for central systems:

.1 Ensure dampers or volume control devices are in fully open position.

.2 Recheck central apparatus.

.3 Recheck all air outlets.

.4 Perform acoustical measurements.

.3 When balancing air outlets:

.1 Rough balance furthest outlets and then balance sequentially back to source.

.2 Fine balance furthest outlet back to source.

.4 Take static pressure readings and air supply temperature readings at 10 points on each air system.

.5 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. Take minimum of 4 total traverse readings. If readings are inconsistent across duct, relocate to two duct diameters or widths and re-do traverse.

.6 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 only by duct internal devices such as dampers and splitters.

.7 Vary total system air quantities by adjustment of fan speeds. TAB contractor **to account for Sheave/Pulley replacements** on fans as required for flow adjustments. Vary branch air quantities by damper regulation.

.8 Where modulating dampers are provided, take measurements and balance at extreme conditions.

.9 Include testing and adjusting of pressure conditions in the final balanced condition of each area.

.10 Check front doors, exits, for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions.

.11 Document abnormal building leakage conditions noted.

.12 Complete balancing to achieve positive building pressure in each room.

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

.2 Participate in system checks twice during Warranty Period - #1 approximately 3 months after Substantial Performance and #2 within 1 month of termination of Warranty Period.

.3 Refer to other Division 23 specifications for additional TAB requirements.

Part 2 Products

Not Used.

Part 3 Execution

.1 The balancing should first try to throttle one side of every system only (be it either a supply side, or an exhaust side), with the other side of the system fully open. Both sides shall be throttled only if the first try results in high motor currents.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Sections to be tested include:

.1 All ductworks

.2 Representative sections totaling no less than 50% of the total installed duct area (both supply and exhaust ducts) for the designated pressure class shall be tested. All sections shall be selected by the Engineer.

1.2 REFERENCE STANDARDS

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

.1 SMACNA HVAC Air Duct Leakage Test Manual.

.3 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook.

.4 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

.5 MMA Supplementary Standard SB-10 for Energy Efficiency Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Specifications.

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:

.1 Submit proposed report form and test report format for approval at least four weeks before proposed date of first series of tests. Do not start tests until approval received in writing from the Engineer.

.2 Prepare report of results and submit to the Engineer within 24 hours of completion of tests. Include:

.1 Schematic of entire system.

.2 Schematic of section under test showing test site.

.3 Required and achieved static pressures.

.4 Orifice differential pressure at test sites.

.5 Permissible and actual leakage flow rate (L/s) for test sites.

.6 Witnessed certification of results.

.3 Include test reports in final TAB report.

.4 Certificates: submit certificates signed by the TAB representative certifying that test criteria comply with specified performance characteristics and physical properties.

.5 Manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meetings:

.2 Verify project requirements.

.3 Review installation conditions.

.4 Co-ordination with other building subtrades.

.5 Review manufacturer's installation instructions for HVAC equipment and warranty requirements.

1.5 TIMING

.1 Ducts to be tested before installation of insulation or any other form of concealments.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, gaskets, etc.

1.6 EXCLUSIONS

.1 Flexible connections to Fans (if any).

1.7 TESTING AGENCY

.1 Certified TAB Contractor as per AABC.

1.8 VERIFICATION

.1 Engineer to witness tests and to verify reported results.

Part 2 Products

2.1 TEST INSTRUMENTS

.1 Testing agency to provide calibrated instruments for tests.

.2 Test apparatus to include:

.1 Fan capable of producing required static pressure.

.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.

.3 Flow measuring instrument compatible with the orifice plate.

.4 Calibration curves for orifice plates used.

.5 Flexible duct for connecting to ductwork under test.

.6 Smoke bombs for visual inspections.

.3 Test apparatus to be accurate to within +/-3% of flow rate and pressure.

.4 Submit details of test instruments to be used to Engineer at least two months before anticipated start date.

.5 Test instruments to be calibrated and certificate of calibration deposited with Engineer no more than 28 days before start of tests.

.6 Instruments to be re-calibrated every six months thereafter.

2.2 EQUIPMENT LEAKAGE TOLERANCES

.1 System leakage tolerances specified herein are stated as a percentage of total flow rate handled by the system. Therefore, when testing sections of ductwork this acceptable leakage shall be pro-rated to entire system. Leakage for sections of duct systems shall not exceed the total allowable leakage.

.2 Leakage tests on following systems not to exceed specified leakage rates.

.1 Low pressure duct systems up to 500 Pa: Leakage 2 % on supply systems and 0% on exhaust systems.

.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

Part 3 Execution

.1 Testing Contractor shall follow the 50-100 approach for ductwork.

.2 Representative sections totaling no less than 50 percent of the total installed duct area shall be tested.

.3 Should the tested 50% fail to meet the requirements of this section, contractor must apply corrective measures to fix the leaks and then 100% of the total installed duct area shall be tested.

.4 All sections shall be selected by the Engineer.

.5 Positive pressure leakage testing is acceptable for negative pressure ductwork.

.6 Do not modify portions of the system for testing, the system should be as close to as installed as possible.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 TEST PROCEDURES

.1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.

.2 Section of duct to be tested to include:

.1 Fittings, branch ducts, tap-ins.

.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

.4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.

.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.4 TESTING

.1 Test ducts before installation of insulation or other forms of concealment.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

3.5 FIELD QUALITY CONTROL

.1 Verify with the Engineer that the calibration records submitted match with tools, instruments and equipment used on the field for testing.

3.6 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto:

.1 American Society of Heating, Refrigerating & Air Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.

.2 Ontario Building Code & MMA Supplementary Standard SB-10 for Energy Efficiency Requirements.

.3 ASTM International (ASTM):

.1 B209, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

.2 C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tabular form.

.3 C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.4 C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.

.5 E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.6 G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.7 G22, Standard Practice for Determining Resistance of Plastics to Bacteria.

.4 Association of the Nonwoven Fabric Industry (INDA), IST 80.6, Water Resistant (Hydrostatic Pressure).

.5 National Fire Protection Association (NFPA):

.1 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

.3 259, Standard Test Method for Potential Heat of Building Materials.

.6 Underwriters' Laboratories, Inc. (UL): 723, UL Standard for Safety Test for Surface Burning Characteristics of Building Materials.

.7 TIAC, Thermal Insulation Association of Canada – Standards Manual for Mechanical Insulation.

.8 CAN/ULC-S102, Standard Method & Test for Surface Burning Characteristics of Building Materials and Assemblies.

.9 CAN/CGSB-51.40 M80, Thermal Insulation, Flexible, Unicellular, Polyolefin Foam Sheet and Pipe Covering.

1.2 DEFINITIONS

.1 Cold Air Ductwork: Designed to convey mechanically cooled air or outside air.

.2 Warm Air Ductwork: Designed to convey mechanically heated air or return ducts in such systems.

.3 Ducting: Includes fittings, drains, accessories, and similar items.

.4 Concealed: Insulated mechanical services and equipment above suspended ceilings and non-accessible chases and furred spaces.

.5 Exposed: Not concealed.

.6 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.7 Thermal Conductivity: The ability of a given substance to conduct heat.

.8 Vapour Permeance: Resistance to water vapor transmission.

.9 TIAC SS:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.3 SUBMITTALS

.1 Product Data: Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations:

.1 Description of equipment giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

.2 Submit the following information in one complete submittal in accordance with Specifications. Indicate the following:

.1 Proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

.2 Operation and Maintenance Data.

1.4 QUALITY CONTROL

.1 Materials furnished under this Specification shall be standard, cataloged products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.

.2 Provide materials by firms engaged in the manufacture of insulation products of the types and characteristics specified herein, whose products have been in use for not less than five years.

.3 ULC Listing or satisfactory certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

.4 Qualifications:

.1 Installer: Specialist in performing work of this section and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Manufacturer's Stamp or Label:

.1 Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to Project site for use must have manufacturer's stamp or label attached, giving name of manufacturer, brand, and description of material.

.2 Insulation packages and containers shall be marked "asbestos-free."

Part 2 Products

2.1 GENERAL

.1 Insulation exterior shall be cleanable, grease-resistant, nonflaking, and nonpeeling.

.2 Insulation shall conform to referenced publications and specified temperature ranges and densities in kg/m^3.

.3 Fire Resistance:

.1 Insulation, adhesives, vapor barrier materials and other accessories, except as specified herein, shall be noncombustible.

.2 Use no fugitive or corrosive treatments to impart flame resistance.

.3 Flame proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.

.4 All materials including insulations, facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued

progressive combustion, and 50 for smoke, developed as per tests conducted in accordance with ASTM E84 (NFPA 255) methods.

.4 Material with a flame spread rating of 25 or less, but exempt from smoke development rating: Flexible unicellular insulation.

.5 Materials exempt from fire resistant rating:

.1 Nylon anchors.

.2 Treated wood inserts.

.6 Materials exempt from fire resistant rating when installed in outside locations, buried, or encased in concrete:

.1 Polyurethane insulation.

.2 PVC casing.

.3 Fiberglass-reinforced plastic casing.

2.2 WARM AIR DUCT INSULATION

.1 Warm Air Duct Insulation - Round and Oval:

.1 Material: flexible mineral fibre blanket insulation to CAN/CGSB-51.11-92.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.

.3 Service Temperature: 20°C to 65°C.

.2 Warm Air Insulation – Rectangular:

.1 Material: rigid mineral fibre insulation to CAN/CGSB-51.10-92.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.

.3 Service Temperature: 20°C to 65°C.

.3 Thickness as per Thickness Schedule

2.3 COLD DUCT INSULATION

.1 Cold Duct Insulation - Round and Oval:

.1 Material: flexible mineral fibre blanket insulation to CAN/CGSB-51.11-92.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.

.3 Service Temperature: -40°C to 65°C.

.4 factory applied reinforced aluminum foil vapour barrier to CGSB 51-GP-52Ma.

.2 Cold Duct Insulation - Round (Exposed to Outdoors):

.1 Material: semi-rigid mineral fibre in roll form.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.

.3 Service Temperature: -40°C to 65°C.

.4 factory applied reinforced aluminum for vapour barrier to CGSB 51-GP-52Ma, Type 1.

.3 Cold Duct Insulation – Rectangular:

.1 Material: rigid mineral fibre insulation to CAN/CGSB-51.10-92.

.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.

.3 Service Temperature: 20°C to 65°C.

.4 factory applied reinforced aluminum foil vapour barrier to CGSB 51-GP-52Ma, Type 1.

.1 Thickness as per Thickness Schedule

2.4 JACKETS

.1 Aluminum:

.1 To ASTM B 209, with and without moisture barrier.

.2 Thickness: 0.5 mm

.3 Finish: Smooth.

.4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

.5 Lagging adhesive: Compatible with insulation.

.6 All joints sealed or flashed to prevent water infiltration

2.5 ACCESSORIES

.1 Vapour Retarder Lap Adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: Hydraulic setting on mineral wool, to ASTM C449.

.4 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.5 Tape: Self-adhesive, aluminum, reinforced 50 mm wide minimum or 75 mm width.

.6 Contact Adhesive: Quick-setting.

.7 Tie Wire: 1.5 mm stainless steel.

.8 Banding: 19 mm wide, 0.5 mm thick stainless steel.

.9 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face.

.10 Fasteners: 4 diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

.1 Pressure testing of ductwork systems to be complete, witnessed, and certified prior to insulation installation.

.2 Surfaces are to be clean, dry, and free from foreign material.

3.2 INSTALLATION OF DUCTWORK INSULATION

.1 General: Install insulation products in accordance with the manufacturer's written instructions and in accordance with recognized industry practices.

.2 Install insulation materials with smooth and even surfaces.

.3 Clean and dry ductwork prior to insulation. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

.4 Maintain integrity of vapor-barrier on ductwork insulation and protect it to prevent puncture and other damage. Tape all punctures.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Seal longitudinal and circumferential joints with FSK tape, and finish with fiberglass mesh fabric embedded in vapor barrier mastic.

.6 Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated.

.7 Install in accordance with TIAC National Standards.

.8 Dimensions shown are clear inside free area measurement regardless of insulation placement. Fabricate ducts accordingly.

.9 Install insulation over entire surface of duct, for full length of duct run including portions of duct passing penetrations through walls and floors.

.10 Install insulation at ambient temperatures within acceptable ratings for tapes, sealants and adhesives.

.11 Supports, Hangers in accordance with Section 23 31 14 – Metal Ductwork.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.2 Install insulation in a manner to insure hangers and standing duct seams do not penetrate insulation.

.12 Fasteners: At 300 mm on-centre in horizontal and vertical directions, minimum two (2) rows each side.

.13 Adhere insulation to round and oval ductwork with adhesive applied in 150 mm wide strips on 400 mm centres. Band on outside with wire until adhesive has set.

.14 Butt insulation and seal joints with lap seal adhesive; cover joint with tape.

3.3 EXPOSED DUCTWORK

.1 Finish insulated exposed ducts with aluminum jacket suitable for paint finish.

.2 Finish insulated ducts exposed to outdoors with aluminum jacket. Caulk all joints on jacket for weather-tight finish. Locate longitudinal joints in least weather-exposed position.

.3 Finish insulated ducts installed in locations that may subject to damage with aluminum jacket.

.4 Indoor concealed ducts: no jacketing required.

3.4 FIELD QUALITY CONTROL

.1 Test factory-applied materials assembled. Field-applied materials may be tested individually.

3.5 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

3.6 INSULATION TYPE AND THICKNESS SCHEDULE

Service Type	**Vapour Retarder**	**Thickness (mm)**	**Example Duct Applications**
"Cold" Ductwork (Air Temperature < 8°C)	Yes	50	Outside Air Ducts Ductwork from exterior openings to duct heater. The last two meters to/form outside louvre or motorized damper whichever is greater.
"Cold" Ductwork (Air Temperature 8- 18°C)	Yes	25	Supply air ductwork downstream of air handling/ duct heaters Exhaust air duct passing through areas other than the one being served

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Comply with the latest edition of the following statutes codes and standards and all amendments thereto.

- .1 Air Movement and Control Association (AMCA): 500, Test Methods for Louvers, Dampers and Shutters.
- .2 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook.
- .3 Association of the Nonwoven Fabrics Industry (INDA): IST 80.6, Water Resistance (Hydrostatic Pressure Test).
- .4 ASTM International (ASTM):
  - .1 A36/A36M, Standard Specification for Carbon Structural Steel.
  - .2 A90/A90M, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc Alloy Coatings.
  - .3 A167, Standard Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip.
  - .4 A176, Standard Specification for Stainless and Heat Resisting Chromium Steel Plate, Sheet, and Strip.
  - .5 A240/A240M, Standard Specification for Heat Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
  - .6 A480/A480M, Standard Specification for General Requirements for Flat Rolled Stainless and Heat Resisting Steel Plate, Sheet and Strip.
  - .7 A653/A653M, Standard Specifications for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
  - .8 A700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment.
  - .9 A924/A924M, Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process.
  - .10 B209, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
  - .11 C916, Standard Specification for Adhesives for Duct Thermal Insulation.
  - .12 C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - .13 E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .14 E96, Standard Test Methods for Water Vapor Transmission of Materials.
- .5 National Fire Protection Association (NFPA):
  - .1 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.3 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

.4 259, Standard Test Method for Potential Heat of Building Materials.

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 Duct Construction Standards.

.2 Guidelines for Seismic Restraints of Mechanical Systems.

.3 Fibrous Glass Duct Construction Standards.

.4 Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.

.5 HVAC Air Duct Leakage Test Manual.

.7 Underwriters Laboratories Inc. (UL):

.1 181, Standard for Safety Factory-Made Air Ducts and Connectors.

.2 214, Tests for Flame-Propagation of Fabrics and Films.

.3 555, Standard for Safety Fire Dampers.

.4 Underwriters Laboratories of Canada (ULC).

.5 National Fire Code of Canada.

.6 National Building Code of Canada.

1.2 DEFINITIONS

.1 The following is a list of abbreviations which may be used in this section:

.1 L/s: litre per second.

.2 m/s: m per second.

.3 kg/m3: kg per cubic metre.

.4 I/A: Intake Air

.5 O/A: Outside Air

.6 E/A: Exhaust Air

.7 R/A: Return Air

.8 S/A: Supply Air

.2 Sealing Requirements: For the purpose of duct systems sealing requirements specified in this Section, the following definitions apply:

.1 Seams: Joining of two longitudinally (in direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on perimeter are deemed to be joints.

.2 Joints, duct surface connections including:

.1 Girth joints.

.2 Branch and subbranch intersections.

.3 Duct collar tap-ins.

.4 Fitting subsections.

.5 Louver and air terminal connections to ducts.

.6 Access door, and access panel frames and jambs.

.7 Duct, plenum, and casing abutments to building structures.

1.3 SUBMITTALS

.1 Action Submittals:

.1 Product Data:

.1 Rectangular Ductwork:

.1 Schedules of duct systems, materials, joints, sealing, gage and reinforcement.

.2 SMACNA Figure Numbers for each shop fabricated item.

.3 Reinforcing details and spacing.

.4 Seam and joint construction details.

.5 Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

.2 Ductwork Accessories:

.1 Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, and finishes, including the following items:

.1 Fittings and volume control damper installation (both manual and automatic) details.

.2 Duct liner.

.3 Sealing materials.

.4 Balancing Dampers;

.5 Duct-mounted access panels and doors.

.6 Flexible ducts.

.7 Sheet metal fasteners.

.8 Informational Submittals:

.2 Record Drawings: Include duct systems routing, fittings details, and installed accessories and devices.

1.4 QUALITY ASSURANCE

.1 Industry Standards:

.1 Unless otherwise indicated or specified, sheet metal ductwork shall be constructed and installed in accordance with SMACNA duct construction standard relevant to ductwork system being provided. These standards are herein referenced as the SMACNA Manual, unless otherwise indicated.

.2 Comply with ASHRAE Fundamentals Handbook recommendations, except as otherwise indicated.

.3 NFPA Compliance: NFPA 90A and NFPA 90B.

.2 Manufacturers: Firms regularly engaged in manufacture of ductwork products of types, materials, and sizes required, whose products have been satisfactorily used in similar service for not less than 5 years.

.3 Suppliers of duct and fitting components shall provide on request the following information:

.1 Laboratory performance data for duct, including leakage rate, bursting strength, collapse strength, seam strength, and pressure loss.

.2 Laboratory performance data for fittings, including zero length dynamic losses.

.4 Installer shall be a firm with at least 3 years' experience of successful installation on ductwork systems similar to that required for this Project.

.5 Changes or alterations to layout or configuration of duct system shall be:

.1 Specifically approved in writing by Engineer.

.2 Proposed layout shall provide original design results, without increasing system total pressure.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Protect ductwork from dirt, water, and debris. During storage on jobsite, keep ends of ductwork covered to prevent foreign objects and water from entering ductwork.

.2 If fabricated sound-lined ductwork gets wet during installation, remove and dispose of ductwork from the site.

.3 Deliver sealant materials to site in original unopened containers labeled with manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi component materials.

.4 Store and handle sealant materials in compliance with manufacturers' recommendations to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

.5 Deliver and store stainless steel sheets with mill applied adhesive protective paper, maintained through fabrication and installation.

1.6 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manuals as detailed in Specifications.

Part 2 Products

2.1 GENERAL

.1 Specified components of this ductwork system, including facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of

continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.

.2 Internally Lined Ductwork: Duct sizes indicated for internally lined ducts are the clear inside dimensions and shall be increased in both dimensions by twice the thickness of the liner.

.3 All ductwork to be sealed as per SMACNA Seal Class C.

.4 Ductwork Interior Surfaces:

.1 Smooth.

.2 No sheet metal parts, tabs, angles, screws, or other items may project into air ducts, unless otherwise specified.

.3 Seams and joints shall be external.

2.2 STAINLESS STEEL MATERIALS

.1 Applies to exhaust ductwork.

.2 Exhaust ductwork shall be rectangular, size as indicated on the Drawings.

.3 304 stainless steel material.

.4 Thickness, fabrication and reinforcement: To SMACNA as indicated.

.5 Where there is a potential for duct contacting a concrete surface, the duct shall be coated with black bituminous paint to prevent corrosion.

.6 Exposed Ductwork: Where ductwork is indicated to be exposed, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains, discoloration, and other imperfections, including those which would impair painting.

.7 Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.3 SHEET METAL MATERIALS

.1 Construct supply metal duct systems from galvanized sheet metal materials.

.2 Galvanized steel with designation zinc coating lock forming quality: to ASTM A653/A653M.

.3 Galvanized Steel ductwork shall not be welded.

.4 Exposed Ductwork: Where ductwork is indicated to be exposed, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains, discoloration, and other imperfections, including those which would impair painting.

.5 Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.4 DUCT SEALING MATERIALS

.1 General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

.2 Adhesives, Cements, Sealant, and Installation Accessories: As recommended by duct manufacturer for application.

.3 Water-Based Sealants:

.1 Listed by manufacturer as nonflammable in wet and dry state.

.2 Manufacturers and Products:

.1 Foster; Series 32.

.2 Childers; CP-145A, 146.

.3 Rectorseal; Airlok 181.

2.5 FIRESTOPPING

.1 50 x 50 x 3 mm retaining angles around duct, on both sides of fire separation.

.2 Firestopping material and installation must not distort duct.

2.6 DUCTWORK FASTENERS

.1 General:

.1 Rivets, bolts, or sheet metal screws.

.2 Ductwork fasteners shall be same metal as duct being supported, unless otherwise noted.

.2 Self Drilling Screws:

.1 Screws shall be hex washer head (HWH) TEKS® self drilling type, formed from heat treated Type 410 stainless steel, complete with bonded metal and fiber washer for dielectric separation.

.2 Manufacturers:

.1 DB Building Fasteners Inc., Santa Fe Springs, CA.

.2 Clark Craft Fasteners, Tonawanda, NY.

2.7 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

.2 SMACNA Seal Classification:

.1 Classification is as required by SMACNA Duct Pressure Classification.

.2 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.3 Class B: longitudinal seams, transverse joints and connections made airtight with sealant or tape or combination thereof.

.4 Class C: transverse joints and connections made air tight with gaskets, sealant tape or combination thereof. Longitudinal seams unsealed. Apply class C seal for this project.

.5 Unsealed seams and joints (not applicable here).

2.8 RECTANGULAR DUCTWORK

.1 Fabricate rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 Ductwork to be built in 500 Pa pressure rating.

.3 Thickness, fabrication, and reinforcement: to SMACNA as indicated.

.4 Transverse joints: proprietary duct joints or SMACNA for Class C ducts

.5 Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 480 mm and larger and are 20 gauge or less, with more than 1.0 square meter of unbraced panel area, as indicated in SMACNA Manual, unless they are lined or are externally insulated.

.6 Where there is a potential for duct contacting a concrete surface, the duct shall be coated with black bituminous paint or approved equivalent.

2.9 RECTANGULAR DUCTWORK FITTINGS

.1 Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 Elbows:

.1 Radiused elbows:

.1 Rectangular: standard radius; short radius with single thickness turning vanes Centreline radius: 1.5 times width of duct.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with single thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45 deg. entry on branch.

.2 Provide volume control damper in branch duct near connection to main duct.

.3 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 deg maximum included angle.

.2 Converging: 30 deg maximum included angle.

2.10 RECTANGULAR DUCTWORK BRANCH CONNECTIONS

.1 Branch duct connections to rectangular duct mains shall be made using **factory fabricated**, field installed taps, with spin-in or mechanical fastened tap to main duct connections.

.2 Field installed/ fabricated taps are not acceptable.

2.11 DUCTWORK HANGERS AND SUPPORTS

.1 General:

.1 Attachments, hangers, and supports for ductwork shall be in accordance with SMACNA Manual referenced for type of duct system being installed unless otherwise indicated on drawings.

.2 Duct hanging system shall be composed of three elements; upper attachment to building, hanger itself, and lower attachment to duct.

.3 Wire hangers are not acceptable.

.4 Hanger Spacing:

.1 Ducts Up to 1500 mm in Largest Dimension: 3.0 m, maximum.

.2 Ducts Over 1525 mm in Largest Dimension: 2.4 m, maximum.

.2 Construction Materials: Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:

.1 Hangers and supports shall be from the same material as the ducts.

.2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.

.3 Hangers: aluminum angle with 304 stainless steel rods to SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50 x 50 x 6	10

.3 Dielectric isolation washers shall be used between aluminum and stainless steel hardware.

.4 Building Attachments:

.1 Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials.

.2 Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 102 mm thick.

.3 Upper Attachment (Concrete):

.1 Drive pin fastener and expansion nail anchor may be used for ducts up to 450 mm maximum dimension.

.2 Threaded stud fastener may be used for ducts up to 900 mm maximum dimension.

.3 Concrete attachments shall be made of dip galvanized or epoxy coated steel.

.5 Duct Fasteners: Sheet metal screws, blind rivets, or self tapping metal screws; compatible with duct materials.

.6 Trapeze and Riser Supports:

.1 Steel shapes conforming to ASTM A36/A36M, hot dipped galvanized after fabrication for Aluminum ductwork.

.2 Stainless steel SS304 for stainless steel ductwork.

2.12 DUCTWORK FLEXIBLE CONNECTIONS

.1 General:

.1 Factory fabricated metal-edged fabric flexible connectors for commercial or industrial applications.

.2 Sheet metal permanently secured to fabric with double fabric fold, double metal crimp.

.3 Comply with NFPA 90A and 90B requirements.

.4 Airtight and waterproof.

.2 Materials:

.1 Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

.2 Metal Edges: Construct from same material as ductwork, unless otherwise noted.

.3 Fabric:

.1 Comply with UL 214 (except teflon coated).

.2 Woven polyester or nylon for most applications.

.3 Woven fiberglass for high temperature applications.

.4 Coating: Vinyl.

.3 Construction:

.1 Fold and crimp metal edge strips onto fabric as illustrated in SMACNA Manual.

.2 Standard Metal Edged Connectors: Strip of fabric 90 mm wide attached to two strips of 70 mm wide sheet metal.

.3 Extra Wide Metal Edged Connectors: Strip of fabric 145 mm wide attached to two strips of 70 mm wide sheet metal.

.4 Transverse Metal Edged Connectors: Strip of fabric 90 mm wide attached to two strips of 110 mm wide sheet metal.

.4 Manufacturers:

.1 Ductmate; PROflex, Commercial.

.2 Ventfabrics.

.3 Duro-Dyne.

2.13 DUCT INSPECTION DOORS

.1 General:

.1 Insulated, gasketed, and at least 375 mm by 375 mm when duct dimensions are large enough.

.2 On ductwork where largest side dimension is less then 400 mm, furnish inspection doors at least 200 mm by 200 mm.

.3 Size: 200 mm smaller than the duct largest dimension (e.g. use 400 mm width access door for a duct with largest dimension of 600 mm).

.4 Supply and Install inspection doors for fire dampers as required by fire damper installation instructions.

.5 Complete with necessary hardware.

.6 Fabricated of same material as ductwork.

.2 Casing and Plenum Access Doors:

.1 Size: 1425 mm high by 600 mm wide minimum where possible.

.2 Complete with hardware, hinges, seals, and latch handles.

.3 Latch Handles: Ventlock, Series No. 260.

.4 Hinges: Venlock, Series No. 200 and No. 300.

.3 Manufacturers:

.1 Ventlock.

.2 Flexmaster.

.3 Duro-Dyne.

2.14 MANUAL DAMPERS

.1 Butterfly Manual Dampers:

.1 Provide volume control damper in branch duct near connection to main duct.

.2 Fabricate from two gauges heavier than duct in which installed, of same material as ductwork.

.3 Align operating handle with damper blade.

.4 Provide 50 mm standoff bracket for insulated duct systems.

.5 Damper Manufacturers:

.1 Ruskin.

.2 American Warming and Ventilating.

.6 Operator Manufacturers:

.1 Accessible Ductwork: Ventlok; Type 620 or 635.

.2 Accessible Insulated Ductwork: Ventlok; Type 639.

.3 Concealed Ductwork: Ventlok; Type 677 with extended operating rod and concealed regulator with plain cover.

.2 Manual Opposed Blade Balancing Dampers:

.1 Externally operated gang airfoil, damper blades.

.2 Fabricate from same material as ductwork.

.3 Stainless steel or nylon sleeve bearings.

.4 Construction shall have interlocking edges and maximum 250 mm blade width.

.5 Manufacturers and Products:

.1 Ruskin; CD102.

.2 American Warming & Ventilating; Model VC 31.

2.15 CONTROL DAMPERS

.1 Refer to Section 23 37 210 – Louvers, Dampers, Intakes & Vents for Automatic Control Dampers.

2.16 EXTERNAL DUCT INSULATION

.1 Refer to Section 23 07 13 - Duct Insulation.

2.17 MISCELLANEOUS ACCESSORIES

.1 Louver and Grille Blank-Off Sections:

.1 Fabricate from 20 gauge sheets of same material as louver/grille.

.2 Line with sound attenuation/insulating material.

.3 Shop prime and paint outside face of blank off section with two coats of flat black exterior paint.

.2 Accessories Hardware:

.1 Instrument Test Holes:

.1 Cast metal, material to suit duct material, including screw cap and gasket and flat mounting gasket.

.2 Size to allow insertion of pitot tube and other testing instruments.

.3 Provide in length to suit duct insulation thickness.

.2 Flexible Duct Clamps:

.1 Stainless steel band with cadmium plated hex screw to tighten band with worm gear action.

.2 Provide in sizes from 75 mm to 450 mm to suit duct size.

.3 Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline, and grease.

2.18 REMOVABLE INSECT SCREENS

.1 General:

Frame	- extruded aluminum channel, 65 mm x 18 mm
	- extruded aluminum angle, 40 x 25 x 3 mm screen frame retainers
Screen Retention Frame	- extruded aluminum with rubber retainer gasket
Insect Screen	- 18 x 14 mesh, .011 gauge, grade 304 stainless steel
Max. Section Size	- 1.5 m x 1.5 m

.2 Mounting:

Ducting Mounting	- "slide out" screen
	- rubber gasket around screen slot in frame
	- cast aluminum handle rigidly attached to screen retention frame. 2 handles per screen section
Face Mounting	- "lift and remove" screen
	- nylon finger pulls, 25 x 30 x 1.5 mm mounted in screen retention frame

.3 In locations where removable insect screen is associated with air control dampers, supply the two units as an integrated, factory assembled unit.

.4 Manufacturer:

.5 T.A. Morrison & Company Inc. Series 6000

Part 3 Execution

3.1 GENERAL INSTALLATION

.1 Miscellaneous:

.1 All stainless steel ductwork shall be TIG Welded per ASME Section IX.

.2 Install sheet metal ductwork in accordance with SMACNA Manual, NFPA 90A, and NFPA 90B.

.3 Install ductwork using manufacturer's recommended adhesives, cement, sealant, and insulation accessories.

.4 Align ductwork accurately at connections, within 3.2 mm misalignment tolerance and with internal surfaces smooth.

.5 Interface Between Ductwork and Louvers: At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork **shall be sloped**, and connected to louver so water entering ductwork system positively drains back to and out of louver.

.2 Ductwork Location:

.1 Locate ductwork runs vertically and horizontally, unless otherwise indicated.

.2 Avoid diagonal runs wherever possible.

.3 As indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment.

.4 In general, install as close to bottom of structure as possible.

.5 For ductwork run above ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.

.6 Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

.7 Ductwork that must transition and drop below piping or other ductwork shall be transitioned back to bottom of structure immediately adjacent to obstruction.

.3 Penetrations:

.1 Provide duct sleeves or prepared openings for duct mains, duct branches, and ducts passing through roofs, walls and ceilings.

.2 Clearances:

.1 For uninsulated ducts, allow 25 mm clearance between duct and sleeve, except at grilles, registers, and diffusers.

.2 For insulated ducts, allow 25 mm clearance between insulation and sleeve, except at grilles, registers, and diffusers.

.3 Closure Collars:

.1 Minimum 102 mm wide on each side of walls or floors where sleeves or prepared openings are installed.

.2 Fit collars snugly around ducts and insulation.

.3 Same gauge and material as duct.

.4 Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier.

.5 Use fasteners with maximum 152 mm centers on collars.

.4 Packing: Mineral fiber in spaces between sleeve or opening and duct or duct insulation.

.5 Coordination with Other Trades:

.1 Coordinate duct installation with installation of accessories, dampers, coil frames, equipment, controls, and other associated work of ductwork system.

.2 Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on Drawings.

.3 Coordinate ductwork layout with suspended ceiling, lighting and sprinkler head layouts and similar finished work.

.4 Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.

3.2 STAINLESS STEEL DUCTWORK

.1 Stainless steel ductwork shall be joined by GTAW per ASME Section IX.

.2 Fully Circumferential Welds on all joints and seams.

.3 Continuous Weld Beads, no intermittent or spot welding allowed

.4 Back-Purging with inert gas (e.g., argon) required for all butt welds to prevent internal oxidation

.5 All welds shall be continuous, free from porosity, cracks, or inclusions.

.6 Weld beads must be smooth with no sharp edges or undercutting.

.7 No flanged or slip joints unless otherwise specified and gasketed appropriately.

.8 Duct supports per SMACNA standards, using stainless or epoxy-coated hangers to prevent galvanic corrosion.

.9 All penetrations (e.g., dampers, sensors) to be sealed gas-tight.

.10 Welder qualification records (WQTR) per ASME.

3.3 RECTANGULAR DUCTWORK

.1 Where possible, install ductwork so seams and joints will not be cut for installation of grilles, registers, or ceiling outlets.

.2 If cutting of seams or joints is unavoidable, reinforce cut portion to original strength.

3.4 RECTANGULAR DUCTWORK FITTINGS

.1 Use bell mouth or conical tee fittings for round duct takeoffs from rectangular mains.

.2 Use 45 degree entry fittings conforming to SMACNA requirements for rectangular takeoffs from rectangular or round mains.

.3 Make offsets with maximum angle of 45 degrees.

.4 Use fabricated fittings for changes in directions, changes in size and shape, and connections.

3.5 RECTANGULAR DUCTWORK TRANSVERSE JOINTS

.1 Install each run with a minimum of joints.

.2 Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

.3 Mechanical Joint Option:

.1 Construct transverse joints with Ductmate 25/35 duct connector systems, W.D.C.I. Heavy/Lite duct connector systems, or Ductlok J/E duct connector system.

.2 When using W.D.C.I. Heavy/Lite system, construct ductwork in accordance to the W.D.C.I. Heavy J and Light H Assembly Manual and Duct Construction Standards.

.3 When using Ductlok J/E duct connector system, construct ductwork in accordance with Ductlok's Rectangular Duct Construction Manual for Low, Medium, and High Pressure.

.4 For longitudinal seams, use Pittsburgh lock seam sealed internally with permanently elastic sealer such as Ductmate 5511M mastic.

.5 Conform to SMACNA Class A sealing requirements.

3.6 DUCTWORK HANGERS AND SUPPORTS

.1 Install ductwork with support systems in accordance with SMACNA Manual, unless otherwise noted.

.2 Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape and to prevent buckling.

.3 Install additional bracing on ductwork as required, to prevent ballooning or breathing.

.4 Support horizontal ducts within 610 mm of each elbow and within 1220 mm of each branch intersection.

.5 Support vertical ducts at maximum interval of 4880 mm and at each floor.

.6 Upper attachments to structures shall have allowable load not exceeding 1/4 of failure (proof test) load but are not limited to specific methods indicated.

.7 In new construction, install concrete insert prior to placing concrete.

3.7 DAMPERS

.1 General:

.1 Inspection:

.1 Inspect areas to receive dampers.

.2 Notify Engineer of conditions that would adversely affect installation or subsequent utilization of dampers.

.3 Do not proceed with installation until unsatisfactory conditions are corrected.

.2 Install dampers at locations indicated on Drawings and in accordance with manufacturer's installation instructions.

.3 Install square and level.

.4 Handle damper using sleeve or frame. Do not lift damper using blades or jack-shaft.

.5 Damper blades and hardware shall operate freely without obstruction.

.6 Damper blades and hardware that bind within frame or obstructed by adjacent construction will not be acceptable.

.7 When installed, damper frames shall be gasketed or caulked to eliminate leakage between duct and damper frames.

.8 Head and sill shall have stops.

.9 Suitable for installation in mounting arrangement shown.

.10 Do not compress or stretch damper frame into duct or opening.

.2 Manual Dampers:

.1 Provide balancing dampers in locations shown on the drawings and for grilles and diffusers in branch duct as near main as possible.

.2 Add or remove balancing dampers as requested by air balancing firm for necessary control of air.

.3 Back Draft Dampers:

.1 Install dampers square and free from racking with blades running horizontally.

.2 Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

3.8 ACCESS DOORS

.1 Ductwork: Install access doors in ductwork, in accordance with manufacturer's instructions, at each:

.1 Duct mounted fire damper.

.2 Duct mounted smoke or ionization detector.

.3 Electric duct heater.

.4 Booster coil.

.5 Humidifier.

.6 Motorized damper.

.7 Sail switch.

.8 Turning vane.

.9 Volume damper.

.10 Automatic damper.

.11 Temperature controller.

.12 Coil, on both upstream and downstream side.

.13 upstream and downstream of inline fans.

3.9 MISCELLANEOUS ACCESSORIES

.1 Inspection Plates and Test Holes:

.1 Where required in ductwork for balance measurements.

.2 Test holes shall be, airtight and noncorrosive with screw cap and gasket.

.3 Extend cap through insulation.

3.10 DUCT SEALING

.1 Seal duct seams and joints as follows:

.1 In accordance with SMACNA requirements.

.2 In accordance with the following:

.1 Pressure Classification Between 500 Pa: Transverse joints and longitudinal seams.

.3 In addition to other requirements, provide the following duct sealing:

.1 For interior ductwork, use brush on duct sealer

.2 If no specific duct sealing requirements are specified, requirements of SMACNA manual shall govern.

.3 Seal externally insulated ducts prior to insulation installation.

.4 Provide additional duct sealing as required to comply with Article - Ductwork Leakage Testing.

.5 Seal all audible leak.

3.11 PAINTING OF DUCTWORK

.1 Not Applicable.

3.12 BALANCING AND TESTING OF AIR SYSTEMS

.1 Perform testing and balancing in accordance with the requirements of Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

.2 Preform Pressure testing and duct leakage test as per Section 23 05 94 – Pressure Testing of Ducted Air Systems.

.3 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

.4 Perform leakage tests in sections.

.5 Perform trial leakage tests, as instructed to demonstrate workmanship.

.6 Install no additional ductwork until trial tests have been achieved.

.7 Test section up to 30 m long with not more than three branch takeoffs and/ or elbows.

.8 Complete tests before insulation or concealment.

3.13 PROTECTION OF INSTALLED WORK

.1 Open ends of installed ductwork systems shall be covered to prevent dust, foreign objects and water from entering ductwork.

.2 Ductwork systems shall not be used for air conveyance until adequate air filtration devices are installed in air handling equipment, to prevent ingress of construction dust.

3.14 CLEANING

.1 Ductwork shall be cleaned of rust, dust, and debris, both internally and externally, before placing in operation.

.2 Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.

.3 If duct systems are found to contain construction debris at time of construction completion Contractor shall provide complete ductwork system cleaning in accordance with NADCA Standards.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA):

.1 ANSI/NFPA 90A- Installation of Air Conditioning and Ventilating Systems.

.2 Underwriters Laboratories of Canada (ULC):

.1 CAN4-S112- Fire Test of Fire Damper Assemblies.

.2 CAN4-S112.2- Fire Test of Ceiling Firestop Flap Assemblies.

.3 ULC-S505- Fusible Links for Fire Protection Service.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Document 01 33 00 – Submittal Procedures.

.2 Indicate the Following:

.1 Fire dampers.

.2 Operators.

.3 Fusible links.

.4 Access/ inspection doors.

.5 Design details of break-away joints.

1.3 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Document 01 78 23 - Operating and Maintenance Data.

.2 Provide the Following:

.1 Six (6) fusible links of each type as spare part.

1.4 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 FIRE DAMPERS

.1 Where indicated in the Contract Drawings, provide curtain type dynamic 3 hr fire dampers:

- .1 An integral sleeve that ensures appropriate sleeve installation and allows delivery direct to the job site.
- .2 3-Hour Rating
- .3 Vertical and horizontal closure spring operation for assured closure under air flow (fans on) in HVAC systems.
- .4 Galvanized steel construction.
- .5 Air flow velocity up to 20 m/s (4,000 fpm).
- .6 Up to 1,000Pa (4” W.G.) static pressure.

.2 Connecting duct sizes: Refer to the contract Drawings.

.3 Acceptable material: DIBD230 from Ruskin or approved equivalent from Greenheck, Nailor and EH price.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 **Provide and install** access doors for all new fire dampers.

.3 Maintain integrity of fire separation.

.4 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.5 Coordinate with installer of firestopping.

.6 Ensure access doors/panels, fusible links, and damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section specifies the provision of ventilation fans, associated dampers included with fans, and their associated accessories as shown on the drawings and as indicated and specified below:

.1 Centrifugal Wall Mounted Exhaust Fans – Belt Drive.

.2 Centrifugal Roof Mounted Supply Fans – Belt Drive.

.2 Fan installer shall provide structural support design drawings for Engineer's review whenever non-manufactured mounting is required for any fan. All fan supports must be designed to accommodate the equipment weight and dynamic load of the fans in operation.

.3 Equipment lists, presented in these specifications and/or as specified in the drawings, are included for convenience and shall not be construed as complete listings of all equipment, devices, and material to be provided under this Contract.

.4 All materials not specifically listed or specified but required to complete the installation are the responsibility of the Contractor.

.5 Refer to HVAC drawings for system configurations.

.6 Refer to Electrical schematic drawings for local control panel and interlock requirements.

.7 Comply with the requirements of Specifications.

1.2 REFERENCES

.1 Conform to the following reference standards:

.1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Rating.

.2 CSA C22.2 No. 113, Fans and Ventilators.

.3 AMCA 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.3 SUBMITTALS FOR REVIEW

.1 Submit the following information in one complete submittal in accordance with Specifications. Indicate the following:

.1 Dimensions

.2 Complete specifications; wiring diagrams (showing all interconnections);

.3 Performance details, acoustical data, fan curves

.4 Motor data

.5 Accessories, weight

.6 Wall, roof and ceiling opening dimensions

.2 Structural support design drawings for non-manufactured mounting

1.4 QUALITY CONTROL

.1 Performance Ratings: AMCA 210 with AMCA Certified Rating Seal.

.2 Sound Ratings: AMCA 301, tested to AMCA 300, with AMCA Certified Rating Seal.

.3 Fabrication: AMCA 99.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for unit heaters for incorporation into manuals as described in Specifications.

1.6 SERVICE CONDITIONS

.1 All fans supplied shall be rated for ambient temperatures and rated for elevation 99 m.

.2 Ambient temperatures shall range from -35°C to 40°C.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, static and total pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.

.4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.2 GENERAL

.1 Supply products modified as necessary by the manufacturer to provide the specified features and to meet the specified operating conditions.

.2 Unless otherwise directed, all fans shall conform to the layout shown on the drawings. Scheduled motor horsepower, sound power levels and outlet velocities not to be exceeded.

.3 Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories cUL 705. For restaurant applications, fan shall be listed by Underwriters Laboratories cUL 762. For smoke control applications, fan shall be listed by Underwriters Laboratories (Power Ventilator for Smoke Control Systems) for US and Canada. Fan shall bear the AMCA certified seal for both sound and air performance.

.4 Statically and dynamically balance fan impellers so no objectionable vibration or noise is transmitted to occupied areas of the building.

.5 Fans are to be capable of accommodating static pressure variations of ±10% with no objectionable operating characteristics.

.6 External static pressure means external to the fan cabinet and all accessories such as backdraft dampers, insect and/or bird screens, mixing boxes, filters, and coils, etc. These accessories if supplied as part of the unit are considered as internal losses for fan.

.7 All fans must be provided with an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure and maximum fan RPM. Fans without nameplates will not be accepted.

.8 Belt driven fans shall be sized for medium drive loss applications.

.9 Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

.10 On belt driven units, bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum life in excess of 200,000 hours at maximum cataloged operating speed. Non-regreasable bearings in a stamped housing will not be acceptable. Provide extended lube lines on all fans.

.11 Belt driven fans shall have single or three phase motors as scheduled. Motors shall be premium efficiency TEFC.

.12 Basis of design is:

.1 Loren Cook.

.2 Acceptable manufacturers are Greenheck and Twin City.

2.3 CENTRIFUGAL WALL MOUNTED BELT DRIVEN EXHAUST FANS

.1 Fan shall be spun aluminum, roof or wall mounted, belt driven centrifugal exhaust ventilator as scheduled.

.2 Wheel shall be centrifugal backward inclined. An aerodynamic inlet cone shall be provided for maximum performance and efficiency.

.3 The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The spun aluminum wall flange shall have pre-punched key slot holes and a mounting template with wall opening location for ease of installation.

.4 Fans to have two-piece top cap with stainless steel quick release latches. Provide bird screen and lifting lugs with the fans.

.5 Provide permanently lubricated ball bearing motors with static resistant belt and adjustable pitch drives. Bearings to be regreasable in a cast iron pillow block housing and rated for 200,000 hours average life.

.6 Fans to be equipped with stainless steel hardware and shaft.

.7 Fan to be provided with Lorenized® finish.

.8 An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from the exhaust airstream.

.9 Motor shall be premium efficiency (minimum 85.5%) ODP types.

.10 All fans factory adjusted to specified fan RPM. Drives to have 1.5 Safety Factor at provided RPM.

.11 For EF-1 & EF-2 include the following accessories:

.1 BD-12 Damper

.2 Orifice Plate 92

.12 For EF-1 & EF-2 include the following accessories:

BD-12 Damper

.13 Each fan to be provided with a manufacturer supplied motorized backdraft damper as shown on contract drawings. Dampers to c/w .020 aluminum blades, .060 aluminum frame, aluminum hinge pins, Brass bushings and non overloading motors.

.1 Design Standard: Loren Cook ACW-B and Greenheck

.14 Maximum Sones: no more than 9.6.

.15 Schedule:

Fan No.	Flow (L/s)	Serving	S.P. (Pa)	Volts/Ph/Hz	RPM	Power (HP)	Design Standard
EF-1	396	Digester Control Building	100	115/1/60	1725	1/3	Loren Cook-120W92
EF-2	396	Digester Control Building	100	115/1/60	1725	1/3	Loren Cook-120W92
EF-1	374	Screw Pump Channel	62	115/1/60	1725	1/4	Loren Cook-120W3B
EF-2	374	Screw Pump Channel	62	115/1/60	1725	1/4	Loren Cook-120W3B

2.4 CENTRIFUGAL WALL MOUNTED EXHAUST FANS

.1 Fan shall be a roof mounted, belt driven, filtered, double width, double inlet centrifugal supply blower with tiered aluminum hood.

.2 Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL/cUL 705) for US and Canada.

.3 The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The louvered hood shall be constructed of extruded aluminum with continuously welded and mitered corners. The removable topcap shall be constructed of minimum 0.064 aluminum. Filters shall be washable expanded aluminum media with two inch formed galvanized frame. The aluminum curb cap shall have continuously welded corners. The internal blower scroll wrapper and scroll side panels shall be a minimum 16 gauge steel and shall have continuously welded seams for leakproof operation. A performance cut-off shall be furnished to prevent the recirculation of air in the fan housing. Bearing support shall be minimum 12ga welded steel. Lifting lugs shall be provided for ease of installation. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.

.4 Aluminum fan components shall be Lorenized™ with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

.5 Wheel shall be aluminum.

.6 Motor shall be Nema design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

.7 Blower shaft shall be AISI C-1045 hot rolled and accurately turned, ground and polished. Shafting shall be sized for a critical speed of at least 125% of maximum RPM.

.8 Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball or roller type in a cast iron pillow block housing and selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

.9 Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

.10 Include the following accessories/ options:

.1 BDIC Intake Damper
.2 Roof Curb
.3 All Aluminum Construction
.4 Aluminum Wheel

.11 Design Standard:

.1 Loren Cook CFS
.2 Greenheck

.12 Schedule:

Fan No.	Flow (L/s)	S.P. (Pa)	Volts/Ph/Hz	RPM	Power (HP)	Design Standard
SF-1	360	125	115/1/60	1725	¾	Loren Cook-120CFS
SF-2	360	125	115/1/60	1725	3/4	Loren Cook-120CFS

2.5 GENERAL FAN ACCESSORIES

.1 Supply the following accessories unless described otherwise in the plans and schedules.

.1 Provide factory installed belt guards on all fans with exposed motors and pulleys for safety. Belt guard shall be constructed of galvanized steel with an open back for inspection and belt tensioning.

.2 Fans shall be supplied with unit mounted factory wired disconnects. Disconnects shall be NEMA 4X rated. Disconnects shipped loose for field wiring by others is not acceptable.

.3 All fans to be completed with motorized damper and actuator. All actuators shall be rated for classified area.

.4 Roof top fans shall be completed with 450mm insulated roof curb supplied by the fan manufacturer.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC fans installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

.1 Install fans in accordance with manufacturer’s instructions, applicable specification, and code requirements.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

.5 Where inlet or outlet is exposed, provide safety screen.

.6 Prime coat fan wheels and housing factory inside and outside. Prime coating on aluminum parts is not required.

3.3 TESTING

.1 Site Tests and Inspections:

.1 Perform tests as directed by Owner/Owner’s Representative to ensure fans are functional.

.2 Obtain reports within 3 days of review and submit immediately to Owner/ Owner’s Representative.

.2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

.3 Manufacturer's Field Services:

.1 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 COMMISSIONING

.1 General: Perform start-up operations in accordance with Section 01 75 10 - Pre-Start-Up, Start-Up and Commissioning, General Requirements and all Division 23 Sections related to start-up, supplemented as specified herein.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section covers the requirements for supply and installation of air supply outlets and inlets, registers and grilles for the ventilation air systems.

.2 Comply with the requirements of Division 1.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Specifications.

.2 Indicate the following:

- .1 Capacity.
- .2 Throw and terminal velocity.
- .3 Noise criteria.
- .4 Pressure drop.
- .5 Face area.
- .6 Neck/ Face velocity

1.3 CERTIFICATIONS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by the manufacturer from an independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 GENERAL

.1 Provide supply and return grilles/ registers to meet capacity, pressure drop, face area, terminal velocity, throw, noise level, neck velocity as specified.

.2 Frames:

- .1 Full perimeter gaskets.
- .2 Plaster frames where set into plaster or gypsum board.
- .3 Concealed fasteners.

.3 Concealed manual volume control damper operators where specified.

.4 Colour: Aluminum coat.

.5 Acceptable product:

- .1 E H Price.
- .2 Titus
- .3 Nailor

2.2 MANUFACTURED UNITS

.1 Registers, grilles and outlets of same generic type shall be product of one manufacturer.

2.3 SUPPLY REGISTERS

.1 Furnish and install Price Model AHCD high capacity drum louver supply outlets complete with damper of sizes and mounting types indicated on the plans and schedule.

.2 The outlets shall have aluminum frame construction, and extruded aluminum drum and vanes.

.3 The outlets shall consist of individually adjustable spread control vanes housed within a rotatable drum.

.4 The vanes shall be bisected by a center divider, allowing separate adjustment of top and bottom blades.

.5 The end panels of the drum shall incorporate spread control members to enhance pattern control.

.6 The drum pivot mechanism shall incorporate a positive positioning detent device to hold field adjusted drum angles of up to thirty degrees off-center. Adjustable vanes shall pivot and maintain blade setting.

.7 The outlet mounting frame shall be constructed of formed steel with welded, reinforced corners for added strength.

.8 The mounting frame shall be supplied with countersunk screw holes for aesthetic appeal.

.9 Paint: All components shall have a baked-on powder coat finish.

- .1 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
- .2 The paint film thickness shall be a minimum of 2.0 mils.
- .3 The finish shall have a hardness of 2H.
- .4 The finish shall withstand a minimum salt spray exposure of 500 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.
- .5 The finish shall have an impact resistance of 80 inch-pounds.
- .6 Paint finish in aluminum powder coat colour.

.10 Outlets to be furnished with heavy duty, opposed blade balancing dampers. The heavy duty, opposed blade balancing damper shall be constructed of a minimum 18 gauge coated, cold rolled steel. The damper frame corners shall overlap and be of welded construction for added strength.

.11 The damper shall be operable from the register face. The damper shall be supplied fitted with a face accessible screw-type blade locking mechanism.

.12 Refer to drawings for the exact number of each register.

.13 Schedule:

Register Tag	Capacity (L/s)	Size (mm)	Quantity	Model no. (Based on EH Price)
SG	On drawing	250 X 450	As Shown on Drawings	AHCD1D/10 X 18/B15

2.4 EXHAUST/ RETURN REGISTERS

.1 Provide high capacity return diffusers with high free area and low sound and pressure drops. The return diffusers shall be mounted directly on the exhaust air duct using proper adaptors.

.2 Construction: Grilles shall be aluminum construction, consisting of an extruded aluminum border and 25 x 25 x 25 mm grid egg crate core.

.3 Paint finish:

.1 All components shall have a baked-on powder coat finish.

.2 The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.

.3 The paint film thickness shall be a minimum of 2.0 mils.

.4 The finish shall have a hardness of 2H.

.5 The finish shall withstand a minimum salt spray exposure of 500 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.

.6 The finish shall have an impact resistance of 80 inch-pounds

.7 Finish color to be Aluminum Powder Coat

.4 Grilles shall be supplied with an aluminum mill finish (DAL) opposed blade damper

.5 Border Style: grilles shall be suitable for exposed duct mounting, complete with a border in the following style:

.1 Exposed duct border for mounting directly to exposed ducts.

.6 Mounting Frames: grilles shall be supplied with a 3/8 inch flat border mounting frame.

.7 Fastening: grilles shall be supplied with the following fastening method:

.1 Countersunk screw holes complete with oval-head screws.

.8 Refer to drawings for the exact number of each diffuser.

.9 Schedule:

Grille no.	Capacity (L/s)	Size (mm)	Model no. (Based on EH Price)
EG	On drawing	500 X 550	82DAL/B15

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as required.

.3 Verify that conditions are suitable for installation.

.4 Verify that field measurements are as shown on the drawings.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section covers the supply and installation of stationary intake and exhaust louvers, penthouse vents and motorized dampers as indicated and as specified in the drawings.

.2 Comply with the requirements of Division 1.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM E90-Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.3 AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

.4 AMCA 511 - Certified Ratings Program for Air Control Devices.

.5 ASTM D7091 (formerly ASTM D1400) – Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals

1.3 PRODUCT DATA

.1 Submit product data in accordance with Specifications.

.2 Indicate the following:

.1 Materials of construction and general assembly.
.2 Construction details.
.3 Coatings and finishes.
.4 Pressure drop charts.
.5 Face areas.
.6 Free areas.
.7 Performance ratings that indicate air flow, and NC designation

1.4 TEST REPORTS

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.5 CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.6 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for unit heaters for incorporation into manuals as described in Specifications.

Part 2 Products

2.1 DAMPERS

.1 This part covers motorized dampers.

.2 Where indicated in the contract drawings provide electrically actuated parallel blade dampers.

.3 Where dampers are in contact with outdoor air and subject to outdoor air temperature, provide thermally-isolated and internally insulated control dampers with motorized actuator as specified. Co-ordinate with actuator supplier to furnish actuator or tandem actuator arrangements according to damper torque requirements.

.4 Insulated dampers shall meet the following requirements:

.1 Frame: 127 x 25 x minimum 3.2 mm 6063-T5 extruded aluminum hat-shaped channel.

.2 Blades: Minimum 1.9 mm 6063-T5 extruded aluminum airfoil type. Blade seals shall be extruded EPDM. Frame seals shall be extruded silicone. Seals are to be secured in an integral slot within the aluminum extrusions. Blade and frame seals are to be mechanically fastened to eliminate shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals are not acceptable.

.3 Action: Parallel.

.4 Insulation: Injected with 2-part, high-density, CFC-free, polyurethane foam.

.5 Thermal Isolation Gap: Each blade underneath tooled blade edge seal pocket. Blade gaskets EPDM or silicone.

.6 Bearings: Maintenance free bearings are composed of a Celecon inner bearing fixed to an aluminum blade pivot pin, rotating within a polycarbonate outer bearing inserted into the frame. No metal to metal or metal to plastic contact. Brass bushings are not acceptable.

.7 Linkage: Concealed in equal flanged frame.

.8 Axles: 13 mm diameter plated steel, hex-shaped, mechanically locked internally into blade.

.9 Drive rods, U bolt fasteners and retaining nuts shall be corrosion resistant zinc plated steel.

.5 Performance:

.1 Total Leakage, AMCA 500: 1.1 m3/min/m2 at pressure differential of 1.0 kPa.

.2 Pressure Drop: 0.02 kPa at 305 m/min across 610 x 610 mm damper mounted in-duct.

.6 Details of actuator mounting to be provided by the Sheetmetal contractor prior to installation for engineer’s review

.7 Damper to be AMCA type A/B rated.

.8 Design standard: Tamco series 9000.

.9 Alternative: Ventex, Ruskin.

2.2 DAMPER ACTUATOR

.1 Provide electrical actuators for the new dampers as indicated on the drawings.

.2 Non-hazardous location damper actuators shall be:

.1 Size actuators to operate dampers at 370 Pa maximum pressure. Use multiple actuators as necessary.

.2 CSA C22.2 and UL listed.

.3 24 V, 60 Hz.

.4 Designed to be directly mounted to damper shaft using mounting clamps.

.5 Visual position indicators.

.6 Built-in auxiliary end limit switches and emergency manual override capable.

.7 Spring safe return.

.8 Running time < 75 seconds.

.9 Adjustable mechanical stop at open position to allow for balancing.

.3 Actuator sizing shall be in accordance to the following guideline (unless higher values are recommended by the damper manufacturer)

.1 Opposed blade with seals – min. 6Nm per sq meter of damper area

.2 Parallel blade with seals – min. 8.5Nm per sq meter of damper area.

.4 Actuator to be Class 1 Div 2 rated.

.5 Design Standard: Schischek

.6 Alternative: Johnson Controls

Part 3 Execution

3.1 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

.4 Verify the damper size with wall opening prior to purchase.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section covers supply and installation of:

.1 Electric duct heaters.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1, Canadian Electrical Code – Part 1.
.2 CSA C22.2 No. 155, Electrical Duct Heaters.
.3 CSA C22.2 No. 72, Heater Elements.

.2 Ontario Safety Electrical Code.

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit product data and include:

.1 Element support details.
.2 Heater: total kW rating, voltage, phase.
.3 Number of stages.
.4 Rating of stage: rating, voltage, phase.
.5 Heater element watt/density and maximum sheath temperature.
.6 Maximum discharge temperature.
.7 Physical size.
.8 Unit support.
.9 Performance limitations.
.10 Clearance from combustible materials.
.11 Internal components wiring diagrams.
.12 Minimum operating airflow.
.13 Pressure drop operating airflow.
.14 Flow switch cut sheet
.15 SCR Controller
.16 Temperature sensor for electronic control
.17 Wiring diagram for Proportional Control and control panel

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for duct heaters for incorporation into manual.

Part 2 Products

2.1 CLASSIFIED DUCT HEATER (EDH-1 & EDH-2)

.1 Duct heaters: Slip-In Type.

.2 Controls:

.1 Proportional SCR

.2 Explosion proof construction.

.3 CSA Approved for Class 1 Div2 location.

.4 No more than 200 degC ignition temperature.

.5 Factory wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.

.6 Remote mounted with terminal strips in heater terminal box for power and control wiring.

.7 Remote controls mounted in a CSA rated enclosure and to include:

.1 Magnetic Contactor Full Break

.2 Automatic Cut-Out

.3 Manual Cut-Out

.4 Transformer c/w Fusible Link

.5 Built-In Air Flow Sensor

.6 Interlock Terminal Strip

.7 Built-in current switch for BAS panel Status

.8 S.C.R. by the Heater Manufacturer

.9 0-10V Stat (CTH291 or approved equivalent and DS600)

.10 Door Interlock Disconnect Switch

.3 Design Standard: Indeeco Ultra-Safe Duct Heater part number 227F29J0236Z-D-K-L-P-V

.4 Approved Equivalent: Thermolec or approved equivalent

.5 Power supply for EDH-1 & EDH-2: 575/3/60;

.6 Opening Dimension: 525 mm x 525 mm x 600 mm

Part 3 Execution

3.1 INSTALLATION

.1 Heaters must be installed by a qualified person familiar with Canadian Electrical Code requirements for hazardous locations as well as any local codes.

.2 Make power and control connections to CSA C22.2 No.46.

.3 Use dielectric isolation between the heater stainless steel duct section, the aluminum ductwork, and the stainless steel bolting hardware.

.4 The heaters must be installed in a position indicated on the drawings. Heaters must be mounted horizontally as shown on the drawings, with the air flow velocity and direction as marked on the data plate to maintain the ignition temperature rating.

.5 The heater must be securely attached to external duct flanges.

.6 The heater must be adequately supported. If the duct flanges will not afford enough support, overhead hangers attached to the lifting lugs may be used for additional support.

.7 Disassembly of heaters for installation is not required and it's not authorized.

.8 The heaters shall be electrically connected to their dedicated air flow switches.

.9 Follow manufacturer's installation instruction and install the duct heater with manufacturer required clearances.

3.2 TESTING

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Elelctrical.

.2 Test internal heater cut-off when the flow drops below minimum, as detected by the heater-mounted air flow switch.

.3 Test interlock between the fans and the heaters. The heater cannot be energized unless the fan relay is powered (energized) from the fan control voltage. Fail a fan and confirm that the heater is immediately de-energized.

.4 Test ventilation panel Off switch. Confirm that the heater is immediately de-energized.

.5 Test fan delay switch (if installed) to assure dissipation of heat after the heater is turned off.

3.3 COMMISSIONING

.1 Commission equipment in accordance with Section 01 75 10 – Pre-Start-Up, Start-Up, and Commissioning.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in presence of Engineer.

.1 Provide test report and include copy with Operations and Maintenance Manuals.

END OF SECTION

Part 1 General

1.1 GENERAL

1. Furnish all labour and materials required to complete all electrical work shown on the drawings and herein specified for the completion of construction.
2. Adjust and install all systems to give proper and satisfactory operation.

1.2 DESCRIPTION

1. Removals:
    1. Remove all the components inside the MCC-6 bucket as described in the demo drawing, .
    2. Remove and dispose existing MCC-5 circuit breaker sections as shown in the contract drawings.
    3. Remove the existing feeder cables powering sludge pump panel and and also dispose of the existing panel as shown
    4. Remove all wiring and conduits associated to mechanical equipment being removed under the scope of this project.
2. Work includes, but is not limited to, the following:
    1. Supply and install new process equipment’s control panels/starter panels as detailed in the contract drawings.
    2. Supply and install new HVAC equipment’s control panels/starter panels as detailed in the contract drawings.
    3. Complete modifications to existing MCC-5 as detailed in contract drawings. Supply and install feeder breakers only from original equipment manufacturers. Update lamacoids on existing MCC to reflect changes.
    4. Supply and install feeder cables to/from MCC to process equipment.
    5. Provide power and control wiring for the new electrical & mechanical equipment and instrumentation as shown on contract drawings.
    6. Supply, installation and connection of power and control cabling for building mechanical and HVAC equipment. HVAC equipment to be provided by HVAC Specification, and supply and installation of wiring and conduits shall be under Electrical Specification.
    7. Testing and commissioning of the operation of new electrical equipment/system and confirmation of co-ordination with existing process.
    8. Electrical Contractor shall assist the General Contractor in the electrical components of removals as detailed in Specifications.
    9. Electrical Contractor shall assist in the testing and commissioning of the plant process, HVAC and instrumentation.

1.3 CODES AND STANDARDS

1. Complete installation in accordance with the latest version of Ontario Electrical Safety Code.
2. Complete installation of overhead and underground systems in accordance with CSA CAN3-C22.3 No. 1 for overhead installations, and CAN3-C22.3 No. 7 for underground installations.
3. Comply with all codes and standards of the local hydro authority and coordinate services with the authority as necessary.

1.4 CARE, OPERATION AND START-UP

.1 Instruct Engineer and operating personnel in the operation, care and maintenance of equipment.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.

.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.

1.5 VOLTAGE RATINGS

1. Operating voltages: to CAN3-C235.
2. Motors, Variable Frequency Drives, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.6 PERMITS, FEES AND INSPECTION

.1 Engineer shall submit to Electrical Safety Authority the necessary number of drawings, specifications, and documents for examination and approval prior to commencement of work.

.2 Engineer shall pay associated fees for plans approval.

.3 Notify Engineer of changes required by Electrical Safety Authority prior to making changes.

.4 Contractor shall arrange for all inspections and pay all fees associated with the certification of the electrical work by the Electrical Safety Authority.

.5 Furnish copies of all inspection reports and Certificate of Final Acceptance from Electrical Safety Authority and any authorities having jurisdiction on completion of work to Engineer.

1.7 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Specification.

.2 Except as otherwise noted, all material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.

.3 Equipment and material to be in accordance with EEMAC and IEEE standards and to be CSA certified for the purpose for which it is to serve. Where there is no alternative to supplying equipment, which is not CSA certified, obtain and pay for special approval from Electrical Safety Authority, Special Inspections Department.

.4 If the Electrical Safety Authority requires testing by an independent testing firm or if an inspection in the manufacturer's place of assembly is required, bear all costs incurred in connection with such tests and inspections.

.5 Control panels and component assemblies are to be factory assembled.

.6 Where specified in the individual product specification section, perform factory tests at the place of fabrication on completion of manufacture or assembly. The Contractor is responsible for all costs associated with factory testing.

1.8 SUBMITTALS FOR REVIEW

.1 Shop drawings to be fully dimensioned specific to the project with complete technical rating information shown.

.2 Catalogue cuts of equipment, devices, and materials requested by the individual specification sections. Catalogue information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc. Edit catalogue cuts to show only the items, model numbers, and information which apply.

.3 Assemble catalogue cuts in a binder. Each binder shall contain a cover sheet, indexed by item, and cross-referenced to the appropriate specification paragraph.

.4 Prepare interconnection diagrams depicting all cable requirements together with their actual terminations.

.5 Provide conduit and duct drawings detailing the routing, building entry locations, floor penetrations, junction box and seal locations.

1.9 SUBMITTALS FOR INFORMATION

.1 Provide the following information as specified in Specifications.

.2 Applicable operation and maintenance information on an item-by-item basis. Operation and maintenance information shall be provided at the time of equipment, device, or material site delivery.

.3 Test results for motors and electrical equipment. Maintain a file of the original test results. Prior to acceptance of work, provide the resulting file to the Engineer.

1.10 LOCATION OF ELECTRICAL EQUIPMENT

.1 The location of any panel, equipment, outlet, raceway and wiring may be changed by the Engineer if the new location is within a limit of 3100 mm radius of the original location. Provide changes without extra cost if requested before installation in the original locations.

.2 Confirm the exact locations of all equipment and devices on site to ensure mounting heights, accessibility and ascertain location and elevations of connecting conduits, piping and other interferences.

.3 Confirm the location of all mechanical equipment, existing equipment and equipment supplied by others in reference to the connections, locations and connection requirements prior to the installation of conduit and wiring to the equipment.

1.11 LOCATION OF OUTLETS

1. Locate outlets 450 mm above finished floor unless indicated otherwise.
2. Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
3. Co-ordinate the location of electrical material and equipment with the work and change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
4. Locate light switches on latch side of doors.

1.12 MOUNTING HEIGHTS

1. Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.
2. If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
3. Install electrical equipment at following heights unless indicated otherwise.
    1. Local switches: 1400 mm.
    2. Wall receptacles:
        1. General: 450 mm.
        2. Above top of continuous baseboard heater: 200 mm.
        3. In mechanical rooms: 1400 mm.
    3. Panelboards: as required by Code or as indicated.

1.13 LOAD BALANCE

1. Measure phase current to panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
2. Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
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.

1.14 CONDUIT AND CABLE INSTALLATION

1. Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
2. If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
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.
4. Minimize the number of conduits and junction boxes on and through the face of the building walls.

1.15 FIRE PROOFING

1. Where cables or conduits pass through floors and walls to hazardous areas and/or fire rated walls, sealing shall be by multi-cable transit or cored holes. Conduits shall be internally sealed in order to prevent gases from egressing through the conduit.
2. Where conduit or cables enter electrical rooms through blockouts, and/or pass through fire rated walls, sealing shall be in accordance with Specification.

1.16 FIELD QUALITY CONTROL

.1 Conduct and pay for following tests:

- .1 Power distribution system including phasing, voltage, grounding and load balancing.
- .2 Circuits originating from branch distribution panels.
- .3 Lighting and its control.
- .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .5 Systems: fire alarm system, communications.

.2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.3 Perform tests as per Section 16011 - Field Inspection and Testing.

1.17 HOUSEKEEPING

.1 Protect electrical equipment from dust, water and damage. Motor control Centres, switchgear, panels and buses shall be wiped free of dust and dirt on the outside kept dry and shall be vacuumed on the inside prior to energizing and testing and again within 30 days of acceptance of the work.

.2 Prior to final acceptance, touch up any scratches on equipment as specified in Item 2.1, Finishes, of this specification.

.3 Protect electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction.

1.18 TIE-INS

1. Where the work requires tie-ins with existing facilities, conform to Specifications and make arrangements with the Engineer to ensure that no unnecessary interruptions or upset of the pumping station occur.
2. Shutdown of any operating or energized facilities shall be coordinated and carried out only by the operating and maintenance personnel of the facility and must be returned to normal operating condition as expeditiously as possible.

1.19 UNDERGROUND CABLE AMPACITY CALCULATION

.1 Once the new underground ductbank has been constructed, and prior to pulling the underground power cable, contractor to perform an underground cable temperature/ampacity calculation based on final ductbank installation details & site conditions and provide a final report with results to engineer in shop drawing format.

1.20 UNDERGROUND CABLE PULL CALCULATION

.1 Once the new underground ductbank has been constructed, and prior to pulling the underground cable, contractor to perform an underground cable pull calculation, and submit to engineer in shop drawing format. Do not proceed to pull new cable until the engineer has reviewed the cable pull calculation and has provided approval.

Part 2 Products

2.1 FINISHES

1. Shop finish metal enclosed surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
2. Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
3. Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
4. Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
5. Apply Galvacon touch-up paint to damaged portions of galvanized surfaces and threads.
6. Equipment or enclosures installed in outdoor locations shall be NEMA 4X.

2.2 EQUIPMENT IDENTIFICATION

1. Identify electrical equipment with nameplates and labels as follows:
2. Nameplates:
   - .1 Manufacture nameplates from lamicoid, engraved lettering and matte finish. Lamicoid 3 mm thick plastic engraving sheet, white background with black letters, mechanically attached with self-tapping screws.
   - .2 Use ultra-violet (UV) protection finish for nameplates used in outdoor installations.

.1 Nameplate Sizes:

.1 Size 1 - 10 x 50 mm - 1 line - 3 mm high letters

.2 Size 2 - 12 x 70 mm - 1 line - 5 mm high letters

.3 Size 3 - 12 x 70 mm - 2 lines - 3 mm high letters

.4 Size 4 - 20 x 90 mm - 1 line - 8 mm high letters

.5 Size 5 - 20 x 90 mm - 2 lines - 5 mm high letters

.6 Size 6 - 25 x 100 mm - 1 line - 12 mm high letters

.7 Size 7 - 25 x 100 mm - 2 lines - 6 mm high letters.

3. Labels: Embossed plastic labels with 6 mm high letters unless specified otherwise.

4. Wording on nameplates and labels to be approved by Engineer prior to manufacture.

5. Allow for average of twenty-five (25) letters per nameplate and label.

6. Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

7. Equipment nameplates to include source of power – distribution panel or MCC.

8. Disconnects, starters and contactors: indicate equipment being controlled and voltage.

9. Terminal cabinets and pull boxes: indicate system and voltage.

10. Transformers: indicate capacity, primary and secondary voltages.

11. On the face of control panels or enclosures which contain power fed from more than one live source, provide a 30 x 90 mm (Type 1 size) warning nameplate inscribed as follows:

.1 CAUTION

.2 CONTAINS MORE THAN

.3 ONE LIVE SOURCE

2.3 CONDUCTOR AND WIRING IDENTIFICATION

.1 Identify each power and control conductor with the complete circuit conductor number at both ends. Use coloured insulation for conductors except that conductors No. 2 AWG and larger may be colour coded with minimum 50 mm wide colour tape.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code to CSA C22.1 and as listed below. For the purpose of colour coding, the drawings take precedence over the specifications.

.1 All control wiring to be provided with wire markers at both ends of the conductor. Wire markers to be heat shrink type with machine printed numbers.

2.4 CABLE IDENTIFICATION

.1 Where cables are installed outdoors, installed in hazardous or corrosive areas, identify wiring at both ends with stainless steel metal embossed tape fastened with stainless steel ties. Acceptable product: metal embossed tape with PAN-STEEL ties by Panduit.

.2 Where wiring is installed indoors, within enclosures, non-hazardous or non-corrosive areas, identify wiring at both ends with permanent indelible machine printed cable tag fastened with "Tefzel" wire ties. Machine print identifying letters and numbers, minimum 3 mm high, on cable tag. Acceptable products: 'Tedlar" computer printable cable tag by Panduit or Brady. "Tefzel' wire ties by Panduit.

2.5 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

.2 Use tin-plated lugs and terminals with nylon insulating materials.

.3 Unless otherwise specified, use pan head terminal screws.

.4 Provide terminals with integral marking strips, permanently identified with the connecting wire numbers.

.5 Minimum ratings for terminal blocks:

.6 Power circuits up to 600 volts: not less than current rating of conductor and not less than 600 VAC.

2.6 MANUFACTURERS AND CSA LABELS

.1 Visible and legible after equipment is installed.

.2 If necessary, obtain duplicate label from manufacturer and install in an accessible location.

2.7 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Safety Authority and Engineer.

.2 Porcelain enamel or decal signs, minimum size 175 x 250 mm.

2.9 EQUIPMENT BASE TEMPLATES

.1 For all major electrical equipment, provide an equipment base template for location of equipment anchor bolts to be embedded in concrete.

.2 Shop finish steel templates for items to be embedded in concrete.

.3 Provide access holes for the placement of grout or concrete, as applicable.

Part 3 Execution

.1 Not used.

END OF SECTION

Part 1 General

1.1 FIELD INSPECTION AND TESTING

.1 Description:

.1 This specification covers the field inspection, testing, checking out and adjustments, if necessary, of all electrical equipment and materials in the completed facility.

.2 All Start-up and Commissioning to conform to the requirements of Division 1.

.2 General:

.1 Workmanship, methods, inspections, and materials used in erection and installation of the subject equipment to conform with the accepted engineering practices, IEEE Standards, Ontario Electrical Safety Code and the Specifications for electrical work.

.2 Perform all wire checks, including factory wiring, setting up all test equipment and any other preliminary work in preparation for the electrical acceptance tests. Inspect all equipment to make sure it has been installed in accordance with the Manufacturer's recommendations.

.3 Each acceptance test shall be witnessed by the authorized representative for the Engineer unless otherwise advised.

.4 Schedule all testing with Engineer's approval and no testing shall be performed without Engineer's approval.

.5 The testing shall be performed by and under the immediate supervision of the Contractor.

.1 Notify the Engineer in writing at least seventy-two (72) hours prior to test establishing the time the test is to be performed.

.6 Field test (as outlined in the following paragraphs) all wire, cable and electrical equipment to assure proper installation, settling, connections, and functioning in accordance with this project's contract drawings, Specifications, and manufacturer's recommendations and perform any additional tests deemed necessary by Engineer to determine that equipment, materials and systems meet the requirements of the project.

.7 Final acceptance will not only depend on equipment dependability, as determined by the subject tests; but will depend on complete operational tests on all equipment to show that the equipment will perform the functions for which it was designed and meet the requirements of the project and specifications.

.8 Manufacturers shall be notified and shall be permitted to witness high voltage or other tests performed on their equipment, if they so request.

.9 No equipment is to be energized without the approval of a designated representative of Engineer.

.10 The following precautions shall be observed prior to energizing any equipment:

.1 Make certain that all construction dirt and debris, conducting material, wire trimmings, and unused or dropped hardware have been removed. All electrical equipment shall be vacuum cleaned to dust free condensation (equipment shall be dried out, if necessary). The enclosures, door or doors, etc., shall then be visually inspected for protective integrity.

.2 Inspect and check all bolted bus connection and bus bracing for proper assembly.

.3 Operate the equipment manually and visually inspect the same for proper clearances of all moving items also making certain that proper lubrication is in evidence.

.11 Furnish all required testing equipment and safety devices including, but not limited to the following items:

.1 500V and 1000V DC meggers, 0-10+ giga ohm scale.

.2 Portable telephone sets and two-way radios, if required.

.3 Battery powered ringing sets.

.4 150-1000V AC voltmeters, 0-500A AC ammeters 1.5% accuracy, General Electric Co. type portable instruments, or as approved.

.5 Volt-OHM-Milli-ammeters, Simpson or as approved.

.6 Micro-ohm meter 10A output.

.7 Phase rotation meters, 60 Hz.

.8 D.C. voltmeter 0-1000V DC.

.9 Rubber gloves, rubber mats, goggles, insulated tools, and any other equipment necessary to ensure safe working condition.

.10 Signals and danger signs.

.11 Miscellaneous cable, switches, receptacles, plugs, etc., as required.

.3 Safety:

.1 The purpose of electrical equipment testing and checking is to determine whether the device will work properly as intended for the specific job to which it is applied. The field testing of apparatus shall, as much as possible, duplicate actual operating conditions, e.g. control circuits energized. In many instances, this requires that the apparatus be in actual use. For safety, however, the testing of live equipment at power voltage shall be avoided whenever possible.

.2 If temporary circuits must be maintained, accidental contact with other circuits and live parts on adjacent apparatus must be prevented. If at all possible, power to adjacent apparatus shall be disconnected prior to testing.

.3 Equipment under test shall be isolated from remote control or feedback circuits to prevent accidental energization by others. If power must be maintained as part of the test, personnel shall be protected against electrical shock by rubber floor mats, rubber gloves, goggles, approved non-conducting safety hats and insulated tools.

.4 Bus runs that have been disconnected for test purposes shall be grounded to prevent feedback of test voltages. If these conductors cannot be grounded, the

test area shall be roped off or otherwise protected from the accidental approach of unauthorized and unnecessary personnel while test is in progress.

.5 Capacitive circuits and any device capable of storing electrical energy received from test voltages are a significant hazard. They shall be grounded during the test, or if they are necessary and included in the circuitry, they shall be grounded after each application of test voltages.

.4 Phasing and Synchronizing:

.1 All power cable and bus duct circuits shall be checked to verify that connections, in regard to phasing, are in accordance with the contract drawings.

.2 All power cable circuits shall be checked to verify that all circuits that can be energized from two or more sources are in phase.

.5 Wire and Cable:

.1 All cable connections must pass visual inspection for workmanship and conformance with standard practice.

.2 All wire and cable shall be tested for continuity.

.3 All cables for 600 V AC circuits shall be meggered with a 1000 V DC megger for one minute. The insulation resistance level shall not be less than 50 megaohms; with the exception of circuit directly connected to existing equipment shall not be less than five megaohms.

.1 During insulation tests all switchboards, panelboards, fuse holders, switches, and overcurrent devices to be in place (except devices with sensitive electronic components recommended by manufacturer not to be meggered).

.2 Motors and transformers shall not be connected during megger test.

.4 Each phase shall be tested between conductor and ground and between phases.

.5 For 600 V cables, the cable megger test shall be held until three equal readings, each one minute apart, are obtained.

.6 Lighting circuits and all 120V power services shall be tested only during construction for continuity and identification and shall pass operational tests to see that the circuits perform all functions for which they are designed.

.7 120 VAC control cable shall be checked by megger tests similar to those described for 600 V wire and cable. Control wiring shall be checked for proper connection in accordance with interconnection diagrams or tables and for tightness of terminal contacts and continuity through each "run" of control circuiting.

.6 Motors:

.1 All motors large and small shall pass a minimum megger reading at room temperature. Any machine not passing this test shall be dried and retested until it either passes or is found unsatisfactory. Test results shall be in accordance with manufacturer's recommendations.

.2 Prior to testing, all rotating equipment shall be inspected for cleanliness, damage, moisture, proper lubrication, oil leaks and phase identification. Proper rotation shall be checked.

.3 The test shall include the connected motor cables. Where magnetic contactors are used, contactor shall be blocked in closed position so that the section of conductor between circuit breaker and magnetic contactor is included in test. Control circuit conductors shall be isolated.

.4 Megger tests shall be applied between all phases tied together and ground. Megger tests shall be taken with motor winding temperatures at room temperature.

.5 Final acceptance of motors cannot be made until the equipment is energized during operational tests. Operational tests shall prove proper rotation and lubrication. The motor shall not have excessive vibration or unusual heating.

.7 Controls:

.1 Electrical controls, circuits and systems shall be tested by trial operation of control equipment after all wiring is completed to see that each interlock and control function operates in accordance with the contract drawings, specifications and the description of operation for the equipment. Where field conditions prevent actual equipment functioning during testing, the Contractor shall simulate the intended operating condition in the associated control circuits.

.2 Locate the cause of any malfunction, within the contractor's scope of responsibility, and make the necessary wiring and/or equipment changes or corrections to obtain the particular systems intended operation as defined by the contract drawings. Costs of these necessary changes are included in the base bid. Such changes shall be included in the test report.

.3 Control panels shall be operated through all design functions. This shall include remote operation of all equipment and actuation of alarms and indicating devices according to design requirements.

.4 Complete operational tests shall be given to all relays, and control devices to show that the equipment performs all design functions and meets design and procurement specifications.

.8 Power factor Capacitors:

.1 With capacitor energized measure and record the current in each capacitor feeder and verify kVAR rating.

.2 After energizing the capacitor disconnect the capacitor and record the capacitor voltage after one minute. This voltage must be less than 50 V DC. Record results for each phase of each capacitor.

.9 Transformers:

.1 Locate, install and ground transformers in accordance with manufacturer's instructions.

.2 Check transformers for dryness before putting it into service if it has been stored on site for any length of time.

.3 Energize transformers and check secondary no-load voltage.

.4 Adjust primary taps as necessary to produce rated secondary voltage at no-load.

.5 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

.10 Metering:

.1 Verify correct PT and CT ratio and that the connection conforms to manufacturer's recommendation.

.2 Voltage, current, kW, pf, harmonics, etc displayed on meter must be verified to Engineer, to be representing actual system characteristics.

.11 Miscellaneous:

.1 All other breakers, switches and contactors shall be given complete operational tests to determine that all design functions are satisfactorily performed.

.2 All switches (control, instrument, disconnect, safety, etc.) shall be inspected and tested as to cleanliness and operation. Contacts so requiring, shall be cleaned before operation.

.3 Switches shall be checked for correct sequence of operation.

.4 Fuses shall be inspected for correct rating.

.5 Coordinate all testing of instruments for those devices.

.12 Test Reports:

.1 During each of the aforementioned tests, maintain a comprehensive set (quantity of duplicates to be determined by Engineer) of test reports defining the specific condition in which the apparatus is left, after it has been given approval for use in its intended service. The completed reports shall become the property of the Engineer.

.2 A checklist type report for each individual item of major electrical equipment should be headed with, but not limited to the following, identification data, defining:

.1 Equipment Name

.2 Item Tag Number

.3 Manufacturer

.4 Type of Class

.5 Application

.6 Plant Location

.7 Voltage Rating

.8 Date of Test

.9 Ambient Conditions

.10 Testers Signature.

.3 Among the specific requirements of testing to determine the equipment is operational condition relative to that particular apparatus, all items shall be visually inspected and evaluated on the report as to its general condition both exterior and interior.

.4 Unless otherwise directed by Engineer, the forms used for testing shall be those that are available by the particular equipment's manufacturer and as per Division 1.

Part 2 Products

.1 Not Used.

Part 3 Execution

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 CSA STANDARD C22.1, Canadian Electrical Code: Part I - latest edition.

.2 Ontario Electrical Safety Code - latest edition.

Part 2 Products

2.1 POWER CABLES: 0 - 1000V

.1 Non-Armored Cable (cable in conduit installation).

.1 Conductors:

.1 Grounding conductor: Stranded bare copper.

.2 Circuit conductors: Stranded insulated copper.

.2 Size:

.1 As required with a minimum size of #12 AWG for power circuits.

.3 Insulation:

.1 XLPE - Chemically cross-linked thermosetting polyethylene

.4 Insulation rating:

.1 Above ground installation: 1000V RW90.

.2 Direct buried installation: 1000V RWU90.

.5 Outer jacket:

.1 PVC - Thermoplastic polyvinyl chloride material, fire retardant marked as FT4.

2.2 INSTRUMENTATION AND CONTROL CABLES

.1 Analogue signals: 4-20mA, 1-5VDC, 0-10VDC.

.2 Digital signals: 24VDC and under pulse type signals.

.1 Twisted pair shielded (TPSH) cables shall be constructed as follows:

.1 Two copper conductors, stranded, tinned, minimum #18 AWG, PVC insulated, twisted in nominal intervals of 50 mm. Conductor identification to be by black and white colored insulation.

.2 Insulated for 600 V, 90ºC.

.3 100% coverage aluminum foil or tape shield.

.4 Separate bare stranded, tinned copper drain wire, minimum #18 AWG.

.5 Overall PVC jacket rated to -40º C and meeting low gas emission and FT 4 flame test requirements set forth in CSA C22.2- No 0.3 and IEEE 383. Overall PVC jacket to be grey in colour.

.6 The entire cable assembly to be suitable for pulling in conduit.

.2 Multi-pair cables to have individual shield as well as an overall shield and overall flame retardant PVC jacket.

.3 Resistance Temperature Detector (RTD) Cables.

.1 RTD cables shall be constructed as follows:

.1 Three or more copper conductors, stranded, tinned minimum #18 AWG.

.2 PVC insulated for 600 V.

.3 100% coverage aluminum foil or tape shield.

.4 Separate bare stranded, tinned copper drain wire.

.5 Overall flame retardant PVC jacket as specified for TPSH cables.

.6 Cables located in cable tray to be armored with overall PVC jacket, in accordance with Paragraph 2.3.

.4 120VAC Control signal and Power to Instruments.

.1 Non-armored cable and Teck cable to be constructed as specified in paragraph 2.1.

.2 Minimum allowable sizes:

.1 120VAC Power to Instruments: #14AWG.

.2 120VAC Control signals: #16AWG.

.3 Insulation rating: 600V, 90ºC.

2.3 WIRE CONNECTORS

.1 The following listings specify products for copper conductors only. Aluminum conductors are not permitted.

.2 Compliance: CSA C22.2 No. 65 and No. 188.

.3 Terminal Connectors.

.1 Ring-type or locking fork-type, crimp-on terminal with nylon insulating sleeve over brazed seam shank.

.2 Minimum rating 600 V, 105ºC.

.3 Conductive member made from electro tin-plated copper.

.4 Limited for use up to No. 10 AWG.

2.4 ELECTRICAL TAPE

.1 To be compatible with conductor or cable insulation or jacketing, as applicable.

.2 For general purpose: vinyl plastic, premium grade, minimum 0.18 mm (7 mil) thickness, black or colour coded, as required. Acceptable product: 3M Super 33 + or 35.

.3 Self-vulcanizing linerless rubber tape, minimum 0.76 mm (30 mil) thickness. Acceptable product: 3M Type 130 C.

Part 3 Execution

3.1 INSTALLATION OF CABLES AND WIRES: 0 - 1000 VOLTS

.1 Install wires and cables in conduits as indicated and in accordance with manufacturer's instructions and these specifications.

.2 Conduits to be tagged in accordance with Section 26 05 00 Common Work Results for Electrical.

.3 Group cable wherever possible on channels.

.4 In-line splices (for power or instrumentation) are not permitted.

.5 Cinch anchors shall be used to fasten the Unistrut brackets to walls. Concrete beams shall not be drilled without prior authorization by the Engineer. Care shall be taken in drilling concrete blocks or masonry work to ensure the surface will not be cracked.

.6 Power actuated fastening tools, e.g. Hilti, shall not be used without written approval from the Engineer.

.7 Where vertical runs are required, and walls, columns or equipment supports are not adjacent, Unistrut channels complete with beam clamps and floor anchor plates shall be provided. Unistrut sections for this purpose shall be sized as required.

.8 Any damage to the jacket of armoured cable shall be immediately repaired in accordance with the manufacturer's recommendation.

.9 Install instrumentation cables in conduit systems or in cable trays. Use a minimum of 300 mm length of liquid tight flexible conduit to connect the field sensors to conduit.

.10 Where instrumentation cables are installed in cable trays, provide barriers in the tray to separate instrumentation cables from power cables.

.11 At each end of the run leave sufficient cable for termination.

.12 Do not make splices in any of the instrumentation cable runs.

.13 Ground cable shields at one end only. Unless otherwise specified, ground the shields at the controller panel.

3.2 CONDUCTOR TERMINATIONS FOR INSTRUMENTATION CABLES

.1 Provide all equipment with terminal blocks to accept conductor connections.

.2 Equip instrumentation conductors terminated at equipment terminals other than terminal blocks with Burndy YAE-2 or STA-KON, self-insulated, locking type terminators. Size as required to fit conductors and screw terminals.

3.3 TESTING OF WIRES AND CABLES

.1 Test all cables in accordance with Specifications.

3.4 GROUND CONDUCTORS IN CONDUITS

.1 Ensure that every conduit is provided with a ground conductor with ampacity to meet Ontario Electrical Safety Code.

3.5 FIRE BARRIERS

.1 Arrange for opening in firewalls and floors, where conduits are to run through.

.2 Make good fire rating of floor or walls as specified in Section 26 05 34 after conduits have been installed.

3.6 IDENTIFICATION

.1 Identify all instrumentation cables as per Specifications and contract drawings.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA C22.2 No. 0.4 Bonding and Grounding of Electrical Equipment (Protective Grounding).

.2 CSA C22.2 No. 41 Grounding and Bonding Equipment.

Part 2 Products

2.1 EQUIPMENT

.1 These requirements are to be used unless indicated otherwise in drawings.

.2 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.3 Insulated grounding conductors: green, copper conductors, sized as indicated or as required by CEC.

.4 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 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.
.7 Approved ground connectors:

Type	Description	Part No.
1	Two bolt hole compression lug for 2/0 cable	Thomas & Betts 54204 series or approved equal
2	Copper compression “C” Tap for connection of copper branch cable	Thomas & Betts 54755 (2/0 to 2/0) 54760 (4/0 to 2/0) or approved equal
3	Two bolt hole flag type for connecting continuous runs of cable to side of cable tray	Thomas & Betts 53055FL or approved equal

4	Mechanical type ground clamp complete with compression lug for bonding ground cable to the flange of structural steel	Thomas & Betts 1BG2-10 Series or approved equal
5	"U" bolt type ground clamp for bonding piping systems	Thomas & Betts 3902B4 Series or approved equal
6	Bolting pad for effectively grounding and bonding tanks, equipment or metal structures to ground grid	Thomas & Betts 52090 Series and/or 52096 Series or approved equal

.5 Oxide inhibitor joint sealant shall be used for all copper crimp connections after the compression.

.1 Deox Oxide Inhibitor or equivalent.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories, etc.

.2 Run ground wire in conduit.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.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.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Connect building structural steel and metal siding to ground by welding copper to steel.

.10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.11 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.12 Provide grounding at all overhead line poles utilizing a grounding rod and wire as specified.

3.2 EQUIPMENT GROUNDING

.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, fire alarm panels, building steel work, distribution panels, outdoor lighting.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 16010 and Section 16011.

.2 Perform ground continuity and resistance tests using a Fall of Potential method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

END OF SECTION

Part 1 General

1.1 ADDITIONAL REFERENCE

.1 Division 1

.2 Division 26

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape, Aluminum, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Support equipment, conduit or cables using clips, spring-loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps:

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.6 Suspended support systems:

- .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
- .2 Support two or more cables or conduits on channels by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.7 For surface mounting of two or more conduits use channels at 3 m o/c spacing.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 Junction Box: A box where conductors are spliced with or without terminal blocks, generally not scheduled on drawings or tagged in field. Junction Box can be used as a Pull Box for some cables.

.2 Terminal Box: A box containing terminal blocks to connect conductors, generally scheduled on drawings and tagged in field as AJB, CJB, DJB and EJB for instrumentation and electrical circuits respectively.

.3 Pull Box: A box used to ease the pulling of conductors. May be a through-pull or a T or X conduit connection, but no splicing of conductors is being done. Generally, not scheduled on drawings or tagged in field.

.4 Panel: An enclosure containing electrical control components such as relays, controllers and the like or an enclosure with a large number of terminal blocks for the purpose of serving as a marshalling point for a number of branch circuits. Scheduled on drawings and tagged in field.

.5 Splitter: An enclosure containing a splitter block or bus bars for the connection of a main circuit and several branch circuits.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Catalogue numbers specified are for the purpose of illustrating features and to establish the grade of quality of the products specified in this section and are taken from one manufacturer's product line. Unless otherwise noted, products from other listed manufacturers that have identical features and characteristics are acceptable.

.2 Acceptable manufacturers (in alphabetical order):

- .1 Appleton
- .2 BEL
- .3 Crouse-Hinds
- .4 Hammond
- .5 Hoffman
- .6 Killark
- .7 Pursley.

2.2 SPLITTERS

.1 Compliance: CSA C22.2 - No. 76.

.2 Sheet metal enclosure, welded corners and formed hinged gasketed cover suitable for locking in closed position.

.3 Main and branch lugs or connection bars to match required size and number of connecting conductors as indicated.

.4 At least three spare terminals on each set of lugs in splitters.

2.3 JUNCTION BOXES AND PULL BOXES

.1 For outlet and conduit boxes refer to Section 26 05 33.16 Boxes for Electrical Systems.

.2 For dry areas such as MCC room utilize rigid PVC or aluminium NEMA 12 enclosures.

.3 For wet and high humidity including the filter area and tank areas utilize Fiberglass-Reinforced Polyester (FRP) NEMA 4X.

.4 For corrosive areas utilize Fiberglass-Reinforced Polyester (FRP) NEMA 4X.

.5 For below-grade or cast-in-concrete application, NEMA Type 4, cast iron alloy body and cover with neoprene gasket.

.1 Flanged with bolted cover.

.2 Flanged with bolted, checkered, flush sidewalk cover.

2.4 TERMINAL AND PULL BOXES

.1 Intended for surface mounting, except as otherwise shown or specified.

.2 Weatherproof Style:

.1 PVC or Copper-free cast aluminium, NEMA Type 4.

.2 Hinged door if any one dimension exceeds 300 mm.

.3 Manufactured breather, designed to maintain weatherproof classification of enclosure.

.4 When used as terminal box, equipped with mounting pan and terminal strip.

.3 Weather- and Corrosion-Proof:

.1 Same features as for weather proof style, except NEMA Type 4X stainless steel or FRP enclosure.

.2 Quick-release latches.

.4 Indoor Dry Location:

.1 PVC or aluminium NEMA Type 12 enclosure.

.2 Hinged cover with quick-release latch or automotive handle, for enclosures which exceed 300 mm in width or height.

2.5 PANELS

.1 Intended for surface mounting, except as otherwise shown or specified.

.2 Single or double door construction.

.3 For dry areas such as MCC room utilize rigid PVC or aluminum NEMA 12 enclosures.

.4 For wet and high humidity including the filter area and tank areas utilize Fiberglass-Reinforced Polyester (FRP) NEMA 4X.

.5 Full size equipment mounting pan of formed sheet metal.

.6 Acceptable manufacturers: Hammond.

2.6 EQUIPMENT MOUNTING HARDWARE

.1 Mounting straps, brackets and fastening hardware designed for the installation of terminal blocks.

.2 Welded studs in sheet metal enclosures to avoid penetration of enclosure walls.

.3 Raised cast bosses in cast metal enclosures, drilled and tapped, for hardware installation.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND PANEL INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount panels with top not higher than 2 m above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items.

.3 Install terminal blocks as indicated using mounting straps and hardware designed for this purpose.

.4 Only main pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit runs between pull boxes as specified in Section 26 05 34.

.5 Install a breather in locations of high humidity and changing temperature conditions; the downgrading to weatherproof of the enclosure will be acceptable.

.6 Where boxes terminate conduits at interior walls below grade elevation, provide a drain hole in the bottom of the box suitable for accumulated moisture drainage.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Ontario Electrical Safety Code.

.2 Establish installation method based on area use; provide concealed installation in finished areas; embed or surface mount boxes on unfinished poured concrete walls as indicated.

.3 Installation methods to be consistently followed in each area.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 OUTLET BOXES

.1 Copper-free cast aluminum single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.3 Electro galvanized steel utility boxes for outlets connected to surface-mounted conduit, minimum size 102 x 54 x 48 mm.

.4 For areas with high humidity values and corrosive environments (filter and tank areas) the outlet boxes shall be made of High impact PVC non-metallic material.

.5 102 mm square outlet boxes with extensions and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

.1 For areas with high humidity values and corrosive environments (filter and tank areas) the outlet boxes shall be made of non-metallic material.

2.4 CONDUIT BOXES

.1 Copper free cast aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

.2 High impact PVC conduit boxes in damp locations or other corrosive areas as shown.

2.5 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.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 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 Where ground stud not provided by manufacturer, drill and tap enclosure housing and install ground stud. Maintain enclosure integrity.

.6 Neatly make cut-outs for outlet boxes recessed in walls of minimum practical size.

.7 Install boxes clear of building and mechanical services equipment.

.8 Where two or more devices are shown at one location, utilize multi-gang boxes, complete with metal barriers where required by Inspection Authority.

.9 Supply all outlet boxes with covers or plaster rings. For flush installations, mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.10 Size boxes to accommodate the number of conduits, conductors and terminal blocks in accordance with Inspection Authority requirements.

.11 Securely fasten surface-mounted boxes to building or mounting structure, support independently and not from conduits entering the box.

END OF SECTION

Part 1 General

1.1 LOCATION OF CONDUIT

.1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

.2 Contractor to provide detailed layout drawings showing location, sizing, materials and fitting location to the Engineer for review prior to construction of any work.

.3 Any adjustments to the conduit location required by the Engineer during shop drawing submittal review or during construction site inspections shall be completed at no additional cost to the Owner.

Part 2 Products

2.1 RIGID PVC CONDUIT

.1 Conduit: Rigid non-metallic conduit of unplasticized polyvinyl chloride, "Scepter" Schedule 40.

.2 Fittings: Threaded male or female solvent weld connectors and solvent weld couplings as supplied by conduit manufacturer.

.3 Solvent: as recommended by conduit manufacturer.

2.2 LIQUID-TIGHT FLEXIBLE CONDUIT

.1 Conduit: Flexible metal conduit with PVC liquid-tight jacket.

.2 Connectors: Captive sealing jacket and ground cone insulated throat, steel, Thomas & Betts Ltd. "SuperTite" Series 6000. Provide sealing rings at all box entries.

2.3 CONDUIT FASTENINGS

.1 Use one-hole PVC straps to secure surface conduits 50 mm and smaller. Use two-hole PVC straps for conduits larger than 50 mm.

.2 Use beam clamps to secure conduits to exposed steel work.

.3 Use channel type supports for two or more conduits at 1000 mm centres.

.4 Use six mm dia. threaded rods to support suspended channels.

2.4 CONDUIT FITTINGS

.1 Use fittings manufactured for use with conduit specified. Coatings to be the same as conduit.

.2 Use factory ALs where 90° bends are required for 25 mm and larger conduits.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Use weatherproof expansion fittings with internal bonding assembly suitable for 100 to 200 mm linear expansion.

.2 Use watertight expansion fittings with integral bonding jumper suitable for linear expansion and 20 mm deflection in all directions.

.3 Use weatherproof expansion fittings for linear expansion at entry to panel.

Part 3 Execution

3.1 RIGID PVC CONDUIT

.1 Use as raceways for following applications:

.1 In underground runs exterior to the buildings unless otherwise noted.

.2 In process areas subject to chemical corrosion as indicated.

.3 In process areas where embedded in concrete, except hazardous areas.

.2 Provide insulated ground wire in all rigid PVC conduits in accordance with the OESC.

.3 Except where embedded in concrete, PVC conduit shall not be clamped tightly but shall be supported in such a manner as to permit adequate lineal movement to allow for expansion and contraction.

.4 Where rigid PVC conduit is set in poured concrete, solvent joints must be completed and allowed to set as per manufacturer's instructions prior to pouring.

.5 Tie PVC conduit securely to prevent movements and broken joints from concrete pour and vibration.

.6 Bend rigid conduit in strict accordance with manufacturer's directions. Distorted bends will not be accepted.

3.2 LIQUID-TIGHT FLEXIBLE CONDUIT

.1 Use as final connection raceway for following applications in process areas:

.1 At all motors, pipe mounted control devices and other devices subject to movement or water.

.2 All instruments.

.2 Provide a ground wire within flexible conduit, bonded to motor frames and system ground.

3.3 WORKMANSHIP

.1 Install all conduit and wiring concealed where practical. Do not recess conduit in columns without permission, except as noted.

.2 Where conduit is run exposed, run parallel to building lines. Where conduits are grouped (two or more) space evenly and so that conduit fittings are accessible for pulling or splicing, make bends concentric and mount on Unistrut racks.

.3 Lay out conduit to avoid interference with other work. Maintain a minimum clearance of 150 mm parallel from steam or hot water piping, vents, etc., with minimum of 50 mm at crossovers.

.4 Slabs on grade: Install rigid PVC in the gravel base below concrete slabs. Provide mechanical protection around stub-ups through slab and extend 150 mm beyond concrete. When rigid steel conduit is installed in contact with earth it shall be protected by 927 primer and Polykin #900 tape. Extend taping 300 mm above finished grade.

.5 PVC conduit installation in concrete pours: Tie down conduit to prevent shifting. All joints are to be made up tight to ensure ground continuity.

.6 Do not place conduit in concrete slabs in which slab thickness is less than four times conduit diameter. Place conduits larger than this size under floor. Conduits to have minimum 25 mm concrete cover.

.7 Organize conduit in slabs to minimize crossovers. Obtain approval and minimum concrete cover required from structural engineer prior to installing conduits in slabs.

.8 All conduit below vehicle traffic shall be in a reinforced concrete envelope as shown on drawings.

.9 Where conduits or ducts enter or exit concrete structures below grade, provide 16 mm x 1500 mm steel reinforcing dowels to prevent shearing. Extend dowel 1000 mm beyond concrete and band conduit to dowel.

.10 Where conduit is installed in floor slabs to run up at equipment or motors, carefully check all conduit locations. Verify conduit locations for mechanical equipment from shop drawings or detail drawings. Brace all stub-ups.

.11 Do not bend conduit in such a way as to reduce pipe cross sectional area at any point.

.12 When conduit runs exceed the equivalent of a 60 m straight run or contain more than the equivalent of three 90° bends, pull fittings shall be used. One 90° bend is to be considered equivalent to 15 m of straight run.

.13 Where possible, install conduits so that they are not trapped. Cap turned up conduits to prevent the entrance of dirt or moisture during construction. Swab out conduit and thoroughly clean internally before wires and cables are pulled.

.14 Take care in reaming ends of all conduit to ensure a smooth, interior finish that will not damage the insulation of the wires.

.15 Use insulated bushings on all conduit terminations.

.16 Ensure electrical continuity in all conduit systems.

.17 All conduit shown exposed in finished areas is to be free of labels and trademarks.

.18 Conduits and ducts crossing building expansion joints shall have conduit expansion fittings to suit the type of conduit used, and shall be Crouse-Hinds, Scepter or FRE.

.19 Seal conduits with duct seal where conduits are run between heated and unheated areas and where conduits enter or leave panels or any other metallic enclosures.

.20 Where conduits pass through walls other than firewalls and Multi-Cable Transits frames, they shall be grouped and installed through openings.

.1 After all conduits shown on the drawings are installed, wall openings shall be closed with material compatible with the wall construction.

.21 Where drawings show conduit designations, these conduits shall be identified at each point of termination, building wall or floor, fire separations and gallery intersection.

.22 Conduit shall be cold cut, square and reamed. All threaded joints shall be made up with an approved thread compound. All conduits shall be made up tight. Pipe wrenches shall not be used on aluminum conduit. After tightening galvanized conduits, fittings, etc., an epoxy-zinc paint shall be applied to cover all wrench marks, breaks in the galvanized coatings and exposed threads.

.23 Use an approved pulling lubricant if required. Provide fish lines in all empty conduits. Fish lines are to be polypropylene rope or nylon line.

.24 Provide Thomas & Betts bullet hubs Series 370/370AL/401 as required at ends of all conduits entering pull boxes, panel switchboards, motor control centres or any other metallic enclosures. Install hubs in all areas.

.25 Provide appropriate transition couplings to underground PVC conduit where they enter buildings (1.5 m out from buildings) and where they rise above grade.

.26 Provide necessary flashing and pitchpockets, making watertight joints where conduit passes through roof or waterproofing membranes.

END OF SECTION

Part 1 GENERAL

1.1 DESCRIPTION

.1 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

.2 Refer to Section 26 05 00 – Common Work Results for Electrical related to this work.

1.2 SCOPE

.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.

.2 All (local) control panels and pushbutton stations indicated on the Electrical Drawings – Elementary Control Diagrams will be supplied, installed and tested under this Section.

Part 2 PRODUCTS

2.1 ELECTRICAL EQUIPMENT OR DEVICE ENCLOSURE RATINGS

.1 Indoor and dry locations: EEMAC 12.

.2 Sprinklered area, below grade, damp or outdoor locations: EEMAC 4X, or EEMAC 3R.

2.2 DISCONNECT SWITCHES

.1 Fusible and non-fusible disconnect switch: size as indicated, enclosure rated for applicable area (see subsection 2.1).

.2 Provision for padlocking in OFF switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated.

.5 Fuseholders: suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action, non-teasible mechanism with visible blade – dead front construction.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Early break auxiliary contact (switch), as indicated.

.9 Acceptable Manufacturers

.1 Westinghouse Canada Ltd.

.2 Square-D (Schneider)
.3 Siemens
.4 Allen-Bradley
.5 Appleton (for hazardous areas only)
.6 Crouse Hinds (for hazardous areas only)

2.3 AC CONTROL RELAYS (INSTANTANEOUS)

.1 General purpose 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, 10 A. 8 or 11 pin plug-in base, complete with hold down clip.

.2 Acceptable Manufacturers

.1 Potter-Bromfield
.2 Agastat
.3 Omron
.4 Allen-Bradley

.3 Control relays supplied by way of long runs of cables/wires are to be heavy duty type or equipped with the surge suppressors to prevent nuisance tripping of the relay.

2.4 RELAY ACCESSORIES

.1 Overlap contact cartridges: supplied in pairs having NO contact that closes before NC contact opens (early make -late break).

.2 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.

2.5 TIMING RELAYS

.1 General purpose 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, 10 A. 8 or 11 pin plug-in base c/w hold down clip.

.2 Potentiometer: self-contained to provide time interval adjustment. Timing range as indicated.

.3 Acceptable Manufacturers

.1 Agastat
.2 Potter-Bromfield
.3 Omron
.4 Allen-Bradley

2.6 PUSHBUTTONS

.1 Momentary contact type: Heavy duty – oil tight, operator flush type, colour as indicated, 1-NO and 1-NC contacts rated 5 A at 120 V AC, labels as indicated.

.2 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 5 A at 120 V AC, labels as indicated.

.3 Pushbutton Ratings

.1 EEMAC type 13 for indoor control panels

.2 EEMAC type 4 for outdoor control panels

.4 Acceptable Manufacturers

.1 Allen-Bradley

.2 Square-D (Schneider)

.3 Siemens

.4 Westinghouse Canada Ltd.,

.5 PB1 Series

2.7 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 120 V AC, labels as indicated.

.2 Switch Ratings

.1 EEMAC type 13 for indoor control panels

.2 EEMAC type 4 for outdoor control panels

.3 Acceptable Manufacturers

.1 Allen-Bradley

.2 Square-D (Schneider)

.3 Westinghouse Canada Ltd.

.4 Siemens

2.8 INDICATING LIGHTS

.1 Heavy duty – oil tight, push to test, transformer type, lens colour: as indicated, supply voltage: 120 V, lamp voltage: 6 V, labels as indicated.

.2 Indicating Light Ratings

.1 EEMAC type 13 for indoor control panels

.2 EEMAC type 4 for outdoor control panels

.3 Acceptable Manufacturers

.1 Allen-Bradley
.2 Square-D (Schneider)
.3 Siemens
.4 Westinghouse Canada Ltd.,
.5 PB1 Series

2.9 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary: as indicated, 60 Hz AC.

.3 Secondary: 120 V or 24 V AC as indicated.

.4 Rating: as indicated plus 20 percent spare capacity.

.5 Secondary fuse kit (terminal block type) with fuse size as required.

.6 Close voltage regulations as required by magnet coils and solenoid valves.

.7 Acceptable Manufacturers

.1 Hammond
.2 Marcus

2.10 CONTROL PANELS – NON-HAZARDOUS AREAS

.1 Control panels shall be rated NEMA4 non-mettalic.

.2 For 575 V and 120 V equipment components a single housing with barriers and separate access doors can be employed, provided the installation complies with Electrical Code Inspection Authority regulations.

.3 Control panel enclosure: as per clause 2.1, constructed with permanently secured oil-resistant neoprene gasket. Mounting and sizing requirements as indicated on drawings.

.4 Control devices: as indicated on Contract Drawings.

.5 Outdoor control panels (EEMAC 4X) including drip shield and an inner panel door.

.6 Control panel wiring: minimum #14 AWG, stranded copper, 600 V thermoplastic insulated, moisture resistant (TEW type).

.7 Wire insulation colours: green-ground, white-neutral, black-phase, red-control.

.8 Strip heaters (as indicated) complete with thermostat, 120 V AC terminal connection, watts as shown, rust resisting iron sheath (750°F max.), insulating bushings. Equal to Chromalux, type SN, or RITTAL type SK.

.9 Control panel finish in accordance with Section 16010 – Electrical General Requirements.

.10 Provide inside terminal mounting board for each panel.

.11 Control terminal blocks: 600 V – 20 A rating, #12 AWG maximum wire size. Equal to Weidmuller type SAK2.5N.

.12 Fused terminal blocks: 600 V – 15 A rating, #8 AWG max. wire size, blown-fuse neon indicator, fuse size as indicated. Equal to Weidmuller type SAKS6.

.13 Acceptable Panel Manufacturers

.1 Hammond Manufacturing
.2 Eurobec
.3 Robroy Industries
.4 Ralston Metal Products Ltd.

Part 3 EXECUTION

3.1 INSTALLATION – GENERAL

.1 Install and/or connect equipment as indicated.

.2 Perform tests in accordance with Section 16010 – Electrical General Requirements and manufacturer's recommendations.

3.2 DISCONNECT SWITCHES

.1 Install disconnect switches complete with fuses as indicated.

.2 Provide all necessary mounting hardware.

.3 Provide disconnect switches – surface mounted on brick, concrete or block walls with 3 mm thick lead washers between enclosure and wall face.

.4 Mounting height: 1500 mm above finish floor level to top of switch enclosure.

.5 Nameplate: Size 4.

3.3 CONTROL PANEL INSTALLATION AND TESTING

.1 Install all operator control panels according to size and type indicated on the drawings.

.2 Arrange and mount pushbuttons, selector switches, etc. on control panels as indicated on drawings.

.3 Where three or more control devices are mounted in single enclosure, wire them to terminal blocks at the bottom of the enclosure for connection of external wiring. Identify all wiring at each termination point with wiremarkers.

.4 Identify each control panel and each corresponding group of control device with nameplates, with identical wording as indicated on drawings.

.5 Arrange all wiring within the control panel systematically so that all circuits can be readily traced.

.6 Wire runs up to ten conductors may be tie-wrapped. For wiring installations exceeding ten conductors, plastic wire ducts with covers shall be used.

.7 Provide terminal block terminations for all outgoing wiring connections including spare terminals totalling at least 25% of those actually used.

.8 Wiring connections to terminal blocks not to exceed two wires per terminal. Use Bridge Bars if more than two wire connections are required.

.9 Provide all terminals blocks with clear plastic snap-on safety covers.

.10 Install all panels true, plumb and square to build lines, and to mounting height specified in Section 16010 – Electrical General Requirements.

.11 Perform tests in accordance with Section 16010 – Electrical General Requirements.

.12 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.

.13 Where ‘control modules’ are supplied by other divisions for panel mounting, coordinate with the appropriate division.

.14 Upon completion of sectional test, undertake group testing.

.15 Check out complete system for operational sequencing.

.16 Install strip heaters in outdoor enclosures to prevent condensation build-up. Install No. 12 AWG, copper, high temperature, heat resistant cables for all connections. Do not drill through enclosure wall to mount strip heater.

.17 Submit to Engineer copies of the test results.

3.4 FUSES

.1 Install fuses in monitoring devices independently before energizing circuit.

.2 Ensure correct fuses fitted to physically match mounting devices.

.3 Ensure correct fuses fitted to assigned electrical circuit.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Specifications.

Part 2 Products

2.1 SWITCHES

.1 15 A, 120 V, single pole, double pole, or three-way switches as indicated.

.2 The switches to be rated according to area classification.

.3 Manually-operated general purpose AC switches with 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.
- .5 Ivory toggle.

.4 Toggle operated, fully rated for LED lighting fixtures, and up to 80% of rated capacity of motor loads.

.5 Switches of one manufacturer throughout project.

.6 Acceptable manufacturers: Arrow-Hart, Bryant, or Hubbell. Switches to be industrial grade.

2.2 LOCAL MOTOR DISCONNECT SWITCHES (FOR ELECTRICALLY MOTORIZED ACTUATORS)

.1 Fuseless Switch Disconnectors serving new electrically operated motorized actuators.

.2 CSA approved.

.3 HP Rated. Rated for 600V, 30A.

.4 Rated NEMA 4X, made of non-metallic material.

.5 OSHA compliant LO/TO Handle.

.6 Unable to open cover when ON Position, cover locked when energized.

.7 Acceptable manufacturers: Siemens, Hubbell. Switches to be industrial grade.

2.3 RECEPTACLES

.1 Receptacles located in T/O Settling Tank areas to be provided with weatherproof covers.

.2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:

- .1 Ivory urea moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and riveted grounding contacts.

.3 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

- .1 Ivory urea moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Four back wired entrances, two side wiring screws.

.4 Other receptacles with ampacity and voltage as indicated.

.5 GFI receptacles as indicated.

.6 Receptacles of one manufacturer throughout project.

.7 Acceptable manufacturers:

- .1 Bryant, Series 5262 Industrial Grade.
- .2 Bryant, Series GFR52.
- .3 Arrow-Hart, 5262 CR.
- .4 Hubbell Canada Inc., 52CM62GY.

2.4 COVER PLATES

.1 Cover plates for wiring devices.

.2 Cover plates to be weatherproof.

.3 Cover plates from one manufacturer throughout project.

.4 PVC cover plates for wiring devices installed in surface mounted PVC boxes.

.5 Stainless steel, vertically brushed cover plates, thickness 2.5 mm for wiring devices mounted in flush mounted outlet box.

.6 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.7 Weatherproof double lift spring-loaded cast PVC cover plates, complete with gaskets for duplex receptacles as indicated.

.8 Weatherproof spring-loaded cast PVC cover plates complete with gaskets for single receptacles or switches.

Part 3 Execution

3.1 INSTALLATION

.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 switch is required in one location.

.3 Mount toggle switches at height specified in Section 26 05 00 Common Work Results for Electrical or as indicated.

.2 Local Motorized Valves & Gates Disconnect Switches:

.1 Units shall be installed as per manufacturer’s recommendations.

.2 Depending the vale or gate these disconnecting means will serve they shall be installed on railing, wall mounted or pedestal mounted. See contract drawings for installation details.

.3 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height specified in Section 26 05 00 Common Work Results for Electrical or as indicated.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.4 Cover plates:

.1 Install suitable common cover plates where wiring devices are grouped.

.2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.3 Protect coverplate finish with paper or plastic film until painting and other work is finished.

END OF SECTION

Part 1 General

1.1 SUBMITTALS FOR INFORMATION ONLY

.1 Submit product data in accordance with Specifications.

.2 Include continuous ratings, fault and withstand ratings.

.3 Include time-current characteristic curves for breakers.

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards in accordance with Specification.

.2 CSA C22.2 No. 5.1- M, Moulded Case Circuit Breakers.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Unless otherwise approved by the Engineer and with the exception specified herein, moulded case circuit breakers to be of one manufacturer throughout.

.2 Acceptable manufacturers (in alphabetical order):

.1 ABB
.2 Eaton- Cutler/Hammer
.3 Square-D
.4 Siemens.

2.2 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips range 3-8 times current rating.

.4 Circuit breakers with interchangeable trips.

.5 Circuit breaker voltage rating, ampacity and poles as indicated. Breaker interrupting capacity to exceed fault level as indicated.

.6 For 600V panelboards breakers to be rated 35kA interrupting capacity (IC) under this project.

.7 For 600/347 V panelboards, fed from 75kVA or smaller transformers, breakers to be rated for 14 kA IC. Panelboards fed from transformers larger than 75 kVA, breakers to be rated 22 kA IC.

.8 For 120/208 V panelboards, fed from 75kVA or smaller transformers, breakers to be rated for 10 kA IC. Panelboards fed from transformers larger than 75 kVA, breakers to be rated 22 kA IC.

2.3 THERMAL MAGNETIC BREAKERS (DESIGN A)

.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 ONLY BREAKERS (DESIGN B)

.1 Molded case circuit breaker to operate automatically by means of magnetic tripping devices with adjustable settings to provide instantaneous tripping for short circuit protection, also referred to as motor circuit protection (MCP).

2.5 FUSED THERMAL MAGNETIC BREAKERS (DESIGN C)

.1 Fused thermal magnetic breakers with current limiting fuses internally mounted. Time current limiting characteristics of fuses coordinated with time current tripping characteristics of circuit breaker. Coordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker. Fuses individually removable and interlocked with breaker. The removal of fuse cover, blowing of a fuse or removal of a fuse, to trip breaker.

2.6 MOULDED CASE SWITCH (MCS)

.1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous, phase, ground faults for circuit protection.

2.7 GROUND FAULT CIRCUIT INTERRUPTER BREAKERS (GFCI BREAKERS)

.1 For sizes 15-40 A, single and double pole 120/240 V.

.2 Similar to design A with the added feature of ground fault protection in excess of 5 mA.

.3 For mounting in panelboards.

2.8 ADDITIONAL FEATURES

.1 Where called for provide:

.1 Auxiliary contacts, one normally open, one normally closed.

.2 ON-OFF locking device

.3 Handle mechanism.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as shown.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Specification.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible disconnect switches within the building shall be in NEMA 4X Fiberglass enclosures.

.2 Fusible and non-fusible disconnect switches within enclosures shall be in NEMA 12 enclosures.

.3 For outside disconnect switches use NEMA Type 4 enclosures.

.4 In a corrosive environment (Filters area) use NEMA Type 4X Fiberglass enclosures.

.5 Provision for padlocking in off position by three locks.

.6 Mechanically interlocked door to prevent opening when handle in ON position. Provide defeater mechanism for opening by trained personnel with an appropriate tool while in ON position.

.7 Fuses: size and type as indicated.

.8 Fuseholders: suitable for type and size of fuse indicated, without adaptors.

.9 Quick-make, quick-break action.

.10 ON-OFF switch position indication on switch enclosure cover.

.11 All switches to be heavy duty.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 Common Work Results for Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section specifies starting equipment for single and three phase motors up to 600 Volts.

.2 Where indicated on the drawings, supply and install starters and all necessary apparatus. Starters to be mounted in independent enclosures as shown on drawings. Wiring and accessories to be as per schematic diagrams.

.3 Where starters have been provided by others, supply and install disconnects and wire to the terminals of the equipment.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Specification.

.2 Indicate:

- .1 Mounting method and dimensions.
- .2 Starter size and type.
- .3 Layout of identified internal and front panel components.
- .4 Enclosure types.
- .5 Wiring diagram for each type and size of starter.
- .6 Interconnection diagrams.

1.3 OPERATION & MAINTENANCE DATA

.1 Provide data for incorporation into maintenance manual specified in Section 26 05 00 Common Work Results for Electrical.

.2 Include operation and maintenance data for each type and size of starter.

Part 2 Products

2.1 MATERIALS

.1 Starters: EEMAC E14-1.

- .1 Half size starters not acceptable.
- .2 Interrupting Capacity: 42 kA (symmetrical) minimum.
- .3 Separately mounted starters in CSA approved enclosure.
- .4 Provide NEMA type 12 enclosures in electrical rooms and control rooms.

.5 All enclosures for mounting outside of electrical rooms and control rooms shall be NEMA Type 4. In a corrosive environment, use non-metallic NEMA Type 4X enclosures.

2.2 MANUAL MOTOR STARTERS

.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One or three overload heater(s), manual reset, trip indicating handle.

.3 Single phase motors equipped with inherent temperature protection only require suitable HP. rated disconnects.

.2 Accessories:

.1 Pushbutton: heavy duty, oil tight. Labeled as per Section 26 05 00 – Common Work Results for Elelctrical.

.2 Indicating light: heavy duty, oil tight.17. Labeled as per Section 26 05 00 – Common Work Results for Elelctrical.

.3 Locking tab to permit padlocking in “ON” or “OFF” position.

2.3 SOLID STATE REDUCED VOLTAGE STARTERS

.1 Modular solid-state controller consisting of a microcomputer logic component and an SCR power unit.

.2 Controller to provide three (3) selectable operating functions:

.1 Soft start to provide smooth stepless starting, adjustable two (2) to thirty (30) seconds.

.2 Current limit/initial torque adjustable from 150% to 500% of full load amperes.

.3 Full voltage start to achieve full inrush current and locked rotor torque.

.4 Pump control ramp from 0 to line voltage, adjustable from two (2) to thirty (30) seconds.

.3 Controller to operate at power characteristic as indicated in drawing.

.4 Soft starter shall have forward and reverse Jog feature

.5 Soft starter to be provided with a full bypass contactor. The bypass contactor is to engage and run the motor after the soft start sequence is complete.

.6 Controller to provide diagnostic and protective features including: Motor overload, start fault, stalled motor, temperature fault, and line fault.

.7 Dual function LED indicators shall be provided for advisory status and fault

annunciation, colour coded for distinct annunciation. Indicators to be mounted in starter compartment door of motor control centre.

.8 The following signals, at minimum, are to be available as dry contact:

.1 Motor overload.

.2 Run status.

.3 Start/Stop.

.4 Ancillary I/O shall be available as part of the completed assembly.

.1 Hand-Off-Auto position.

.2 Emergency Stop.

.9 A digital interface display (DIM) shall be provided and door mounted onto the enclosure assembly. Full configuration and status information shall be available on the display.

.10 The power unit shall be capable of operating at the following conditions:

.1 Pump control ramp from 0 to line voltage, adjustable from two (2) to thirty (30) seconds.

.2 Selectable Current Limit: Adjustable from 150% to 500%.

.11 Repetitive peak inverse voltage rating 1600 V at 600 V line voltage.

.12 Units to be mountable in motor control sections shown and specified.

.13 Provide moulded case circuit breaker in accordance with Section 26 28 16.

.14 Provide isolation contactor to provide automatic isolation of the controller and motor circuit when controller is shut down.

.15 Where specified, provide power factor capacitor contactor and time delay relay, adjustable to switch on capacitors when motor has been running at full speed for thirty (30) seconds.

.16 Provide control relays as indicated.

.17 Two sets normally open and normally closed auxiliary contacts in addition to standard auxiliary holding contacts.

.18 Soft starter panel shall have fan for adequate ventilation with adjustable temperature switch.

.19 Acceptable Manufacturers (in alphabetical order):

.1 ABB (PSTX Series only)

2.4 FULL VOLTAGE NON-REVERSING MAGNETIC STARTERS

.1

.2 Full voltage magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

- .1 Contactor three-pole, solenoid operated rapid action type.
- .2 Motor overload protective device in each phase, manually reset from outside enclosure.
- .3 Adjustable solid-state overload devices ambient compensated type.
- .4 Power and control interface terminals strips.
- .5 Wiring and schematic diagram inside starter enclosure in visible location.
- .6 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.3 Accessories :

- .1 Pushbuttons, selector switches: heavy duty, oil tight. Labeled as per Section 26 05 00 Common Work Results for Electrical.
- .2 Indicating lights: heavy duty, oil tight. Labeled as per Section 26 05 00 Common Work Results for Electrical.
- .3 Auxiliary contacts.
- .4 Control Power Transformers.

2.5 FULL VOLTAGE REVERSING MAGNETIC STARTERS

.1 Identical features as for full voltage non-reversing magnetic starters, except:

- .1 Two - 3 pole magnetic contactors mounted on common base.
- .2 Mechanical and Electrical Interlocks to prevent both contactors from operating at the same time.

2.6 MULTI-SPEED STARTERS

.1 Identical features as for full voltage non-reversing magnetic starters, except:

- .1 Suitable for separate winding motors, unless otherwise specified.
- .2 One-3 pole magnetic contactor for each winding.
- .3 Three overload relays for each speed.
- .4 Automatic sequence relays for each speed, where shown.

2.7 COMBINATION TYPE STARTERS

.1 Combination type starters to include motor circuit protector with operating lever on outside of enclosure to control motor circuit protector, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open and provision for preventing opening door when switched in "ON" position. Provide a defeat mechanism for starters in MCC.

.4 Starters shall be minimum size NEMA/EEMAC 1. Control devices, terminals blocks, auxiliary contacts, etc., to be included as required to comply with control schematics.

2.8 SOLID-STATE OVERLOAD RELAYS

.1 The overload relay to have following features:

.1 Single phase protection.

.2 Ambient temperature compensation.

.3 Manual or automatic reset field selectable.

.4 Visual trip indication.

.5 Full function test button.

.6 Two sets of isolated alarm contacts.

.7 Solid-state protection, accurate to ±10%.

.8 Adjustable tripping, Class 10 through 30.

.9 LED diagnostic and status indicator.

.10 Self-monitoring.

2.9 CONTROL TRANSFORMERS

.1 Each control transformer to be rated 600-120 V, single phase, 2 wire, 60 Hz. Size the transformer for the load it feeds but not less than the minimum ratings as follows:

EEMAC Starter Size	Minimum Transformer Volt-Ampere Rating
1	100
2	150
3	200
4	300

.2 Provide each control transformer with time-delay, slow-blow secondary fuse rated to interrupt 10 kA short circuit at 250 V AC. Provide two primary fuses rated to interrupt 50 kA at 600 V on all starters.

.3 Fuse holder for secondary fuse shall be properly rated for control voltage. Fuse holders for primary fuses shall be dead front fuse clips with full barriers between fuses.

.4 Acceptable manufacturers: Hammond or Rex.

2.10 TRANSIENT SURGE SUPPRESSOR

.1 Provide a transient surge suppressor in each starter. Encapsulate suppressor in a small module suitable for mounting directly to the starter coil. Additional panel space for suppressor shall not be required. Suppressor to be rated 120 V AC.

2.11 AUXILIARY CONTACTS

.1 Contactors to be equipped with auxiliary contacts, rated 10 A at 120 V AC. Unless otherwise specified on the drawings, each contactor to be equipped with one spare normally open and one normally closed, field convertible, electrically isolated auxiliary contacts. Wire auxiliary contacts out to terminal blocks. Refer to drawings for actual quantities required.

2.12 TERMINAL BLOCKS

.1 Provide quick disconnect on terminal blocks to allow terminal block to be pulled without wiring disconnection.

.2 Provide terminal blocks of screw type rated 600 V; 20 A for control wiring and 30 A power wiring (starters size 3 and larger shall terminate the power leads directly to the contactor). Supply the number of terminal blocks shown on the drawings.

.3 On starters size 4 and larger, provide terminals for connection of the conductors for power factor correction capacitors between the contactor and overload relay as indicated on the drawings.

.4 Provide terminal blocks with integral marking strips permanently marked with the conductor number as specified on the drawings.

.5 Internal wiring to be connected on one side of the terminal block; outgoing conductors to be connected to the other side.

.6 Acceptable manufacturers: Entrelec, Phoenix, Allen Bradley, Cutler-Hammer or Weidmuller.

2.13 AC CONTROL RELAYS

.1 Control relays for control and instrument panels shall be plug-in types with clear polycarbonate covers, 120 V AC, 60 Hz, unless otherwise indicated on the drawings.

.2 Plug-in relays shall have a minimum contact rating of 10 A, mechanical life expectancy 10 million operations, operating temperatures -45°C to +50°C, dielectric strength 1500 V AC for one (1) minute.

.3 The exact type of relay shall be determined from the number of contacts used as shown on each control diagram as indicated on the drawings. The minimum number of contacts to be DPDT. If more than three contacts are shown, parallel relays shall be used.

.4 All relays to provide indication of whether the relay is energized or not.

.5 Acceptable products: Entrelac.

2.14 ELAPSED TIME METERS

.1 Elapsed time meters shall be calibrated in hours, suitable for door mounting, non-resettable, 120 V AC. Veeder-Root 7795 Series or reviewed alternative.

2.15 PUSHBUTTONS

.1 Operator flush type, as indicated. Black with 1-NO and 1-NC contacts rated at 10 A, ac, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position.

.2 Approved Product: Allen-Bradley 800T series, Square D.

2.16 SELECTOR SWITCHES

.1 Maintained two or three positions labeled as indicated, operators standard knob, contact arrangement as indicated, rated 120 V AC, 10 A.

.2 Local- Remote switches to be make before break.

.3 Approved Product: Allen-Bradley 800T series, Square D.

2.17 INDICATING LIGHTS

.1 Transformer type, push-to-test, lens colour as indicated, supply voltage: 120 V AC, labels as indicated.

.2 Approved Product: Allen-Bradley 800T series, Square D or Cutler-Hammer.

2.18 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.19 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section– 26 05 00 Common Work Results for Electrical.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload device elements are installed.

.3 Provide and configure all settings for the starters.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of soft starter, starters, contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 The following specification describes the minimum requirements for the design, fabrication, test, installation and documentation of variable frequency drives and associated equipment.

.2 The VFDs for the Sludge pumps are intended to be installed in a wall mounted local control panel c/w indicating lights, pushbuttons and switches (as indicated in contract drawings), output filter and be pre-wired from the manufacturer. The control panel shall be constructed in the manufacturers shop as a complete unit. The control panel shall not be field constructed with separate components being installed from different suppliers.

1.2 CODES AND STANDARDS

.1 If this specification or the referenced drawings conflict in any way with the requirements of the applicable codes and/or standards, the more rigorous requirement shall prevail. Manufacturer shall be responsible for the compliance with applicable codes and/or standards.

.2 The equipment shall be designed, manufactured and tested in accordance with the latest applicable revisions of the following standards:

.1 CSA C22.2 No.14 Industrial Control Equipment.

.2 IEEE 519 Harmonic Control in Power Systems.

.3 IEEE C62.41 Surge Voltages in Low Voltage AC Power Circuits.

.3 All units to be CSA/ULC approved.

1.3 SUBMITTALS FOR REVIEW

.1 Prior to demolishing the existing sludge pump VFDs, contractor shall retrieve all existing VFD parameters on the existing sludge pump VFDs and submit them as a record shop drawing.

.2 Submit copies of shop drawings as per Specification.

.3 Provide:

.1 Catalogue and technical data for each VFD and associated equipment.

.2 Outline dimensions, shipping section dimensions, weight and foundation or mounting requirements for all assemblies.

.3 Electrical and control schematics.

.4 Diagram showing function and identification of all terminals requiring field connections.

1.4 OPERATION AND MAINTENANCE

.1 Submit copies of the following for information as per Specification.

.1 Operation and maintenance data for variable frequency drives for incorporation into plant operation and maintenance manual.

.2 Troubleshooting flowcharts for all device faults.

.3 An instruction manual for programming.

.4 Setting sheets with a record of all VFD parameter settings as configured during drive commissioning.

1.5 QUALITY ASSURANCE

.1 The drive shall be CSA/ULC approved and shall bear labels indicating so.

.2 Quality Assurance requires the drive to be CSA approved and labeled. The VFDs are to be supplied by this section. VFDs must meet the load requirements of the pumps.

Part 2 Products

2.1 GENERAL

.1 Acceptable manufacturers: ABB, Allen-Bradley or Danfoss.

.2 Application: variable torque unless otherwise noted.

.3 Each VFD shall consist of the following major components:

.1 Disconnect Switch

.2 Input Contactor

.3 VFD controller c/w Input Reactor (3%)

.4 Output Filter (3%)

.5 120 VAC control power transformer. Approved Manufacturer: Hammond or Rex.

.6 Phase to phase and phase to ground MOV line voltage transient protection.

.7 Customer interface include LCD digital display, programming keypad and operator keys option.

.8 Microprocessor based inverter logic isolated from logic circuits.

.9 All doors shall be equipped with heavy duty hinges and shall be designed not to visibly sag, twist, or warp under the weight of installed relays and instruments, regardless of the position of the door.

.4 VFDs shall be of the pulse-width-modulation type and shall use bipolar transistors or latest generation IGBTs. SCRs and thyristors are not acceptable.

.5 VFDs shall use six (6) pulse rectifiers with (2 x Internal DC chokes and output filter as specified).

.6 VFD shall be sized for variable torque (fans and pumps) unless otherwise indicated.

.7 VFD shall be CSA approved and UL recognized.

.8 All materials and equipment shall be new.

.9 The VFD shall include a full-wave diode bridge rectifier and maintain a displacement power factor of near unity regardless of speed and load. The 600V class model shall be capable of accepting 600VAC input power and have additional TVS (Transient Voltage Suppressor Diode) in addition to MOVs (Metal Oxide Varistors) for transients and surge protection.

.10 The DC link choke shall have individual fuse protection.

.11 Protection shall be provided for AC line or DC bus over voltage of rated maximum or under voltage of rated minimum and input phase loss.

.12 Output short circuit and ground fault protection rated for 50kA shall be provided per UL508C without relying on line fuses. Motor phase loss protection shall be provided.

.13 The cooling fans shall be arranged so that the airflow is channeled through a contained compartment, separated from the electronic components. Air intake shall be from the FRONT of the drive. Electronic components (PC boards, DC link capacitors, relays, etc.) shall not be located in the main air flow stream unless design assures that such devices will not be contaminated by environmental pollutants. No side ventilation is permitted.

.14 The individual drives will be capable of being controlled from a PLC control system.

- .1 A 4-20 mA signal input will be the speed control in "AUTO" mode of operation.
- .2 The drive shall have an analog feed back 4 - 20 mA signal, programmable to represent speed.
- .3 The drive shall have an analog feed back 4 - 20 mA signal, programmable to represent current.
- .4 All analog signals shall be isolated from one another using galvanically isolated modules employing at least 1.6 kV isolation between the primary and secondary.
- .5 Digital inputs shall include contact outputs from the external control circuitry to start and stop the VFD using maintained logic.
- .6 Contact outputs representing “Run” and “Fault” signals shall be available from the VFD for connection to the PLC.
- .7 Provisions for accepting inputs from "AUTO/OFF/HAND" switch and door mounted control keypad. A contact output shall be available from the switch in AUTO for connection to the PLC.
- .8 Alarm lock outs and indication shall be provided for Pump High Temperature, Pump High High Temperature, Pump Low Low Level, Pump High Pressure and Pump Low Pressure as shown on drawings. Indication shall be on the VFD door and in the PLC.

.15 To the extent that is practical, only fireproof and flame-retardant materials shall be used.

.16 The VFD shall utilize DC link capacitors made with plastic foil technology instead of electrolyte. Electrolyte DC bus capacitors are not acceptable.

.17 The VFD shall have 1.5 to 10 kHz switching frequency capability with Automatic switching frequency reduction in case of overheating.

.18 VFD shall utilize all varnished boards for increased resistance to environmental factors.

.19 VFD shall have built in Class C2 EMC filtering. No external EMC filters shall be accepted.

.20 VFD shall be designed to have minimum of 57 years mean time between failures or 501858 hours.

.21 The VFD shall have built in the following fieldbus interfaces, Ethernet, Modbus RS-485, Modbus TCP, Modbus RTU, BACNET IP, Profinet IO. No communication cards or gateways for the above communication protocols shall be acceptable.

.22 The VFD keypad shall be large enough to monitor up to 9 signals at the same time.

.23 The selected VFD shall have a display with “Fault, Cause and Remedy” details on the screen for easy troubleshooting. VFDs which display only fault codes are not acceptable.

.24 All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.

.25 The VFD shall provide two user programmable relays. Two form ‘C’ 230VAC/2A rated dry contact relay outputs shall be provided. A third READY relay output shall be provided as standard (interchangeable for a thermistor input upon request).

.26 Furnish equipment to include all the necessary features, components, accessories and apparatus whether mentioned in this specification or not. These shall include, but shall not necessarily be limited to the following:

.1 Necessary steel lifting beams for handling controller line ups which were segmented for shipping.

.2 Provision for lifting, rolling and jacking of controller or subsections for installation, maintenance and inspection.

2.2 DRIVE SPECIFICATIONS

.1 Input Power

.1 The drives shall be capable of operating with the following parameters:

.1 Input voltage: 600V AC, 3 phase, @10%

.2 Input line frequency: 60 Hz, @3%

.3 Line transients: 10% harmonic distortion

.4 Efficiency: 97% (at full load)

.5 Displacement power factor: Between 1.0 and 0.95 lagging over the entire speed range

.6 DC Choke: 2xDC Chokes or built-in 3% line reactor.

.2 Output Power

.1 The drives shall meet the following requirements:

.1 Output Voltage Range: 0 - 600V AC, 3 phase

.2 Output Frequency Range: 0- 100 + Hz

.3 Frequency Stability: 0.0 1 % of maximum frequency setting

.4 Wave shape function: PWM / DTC

.5 Speed Control Accuracy: 0.3% (at full load)

.6 Overload capability: 150% for 60 seconds

.3 Control Specifications

.1 The drives shall have the following minimum control requirements:

.1 Operate drive with motor disconnected.

.2 Controlled shutdown with no component failure in the event of an output phase to phase or phase to ground short circuit fault.

.3 Multiple programmable stop modes includes-pump curve, ramp, coast, DC brakes, S-curve and ramp-to-hold.

.4 Multiple acceleration and deceleration rates and allow setting to be adjusted from 0 secs to 3600 secs.

.5 Ability to configure the volts per hertz for square, automatic and linear pre -programmed.

.6 The programmable speed regulation mode shall include:

.1 Open loop

.2 Slip compensation with 5% speed regulation

.3 Droop-negative slip compensation

.4 Traverse function

.5 Process PI control

.6 Closed loop encoded feedback with 0.1%

.7 Pump Start.

.2 The control logic shall be capable of “riding through” a power outage of up to 2 seconds.

.3 The last four faults as well as operating frequency, drive status and power mode are to be stored at the time of fault.

.4 A flying start feature capable of determining the speed and direction of a spinning motor and adjusting the VFD output to pick-up the motor at the rotating speed without damage to VFD or motor.

.5 The drive shall provide electronic motor overload protection which is speed sensitive and adjustable to motor speed ratio, over temperature protection.

.6 Provide an option for start, stop, jog, reverse and speed control as an integral part of the Human Machine Interface.

.7 If completed with Input line reactors this shall be integral to the VFD and be of Iron Core, Class H insulation, Copper wound, 115º C rise, 60 Hz, and mounted and wired inside the enclosure.

.8 The drive shall reduce the output voltage automatically when the drive is operating in an idle mode and return to normal with load increase.

.9 VFD to provide stable current waveform.

.10 HMI digital:

.1 Removable type with integral display to show drive operating conditions, adjustments and fault indications.

.2 Consists of 2 lines of 16 character alphanumeric, backlit LCD.

.3 Provide LED indication of drive direction and commanded direction.

.4 Capable of remote mounting.

.11 All adjustment to be done by digital interface and stored in nonvolatile memory (EFPROM) for factory default values.

.4 Environmental Specifications:

.1 Each drive shall be capable of operating under the following conditions:

.1 Ambient Operating Temperature: 0 to 40 ºC

.2 Ambient Storage Temperature: - 40 ºC to 70 ºC

.3 Humidity: to 95%, non-condensing

.4 Altitude: 1000 metres without derating.

2.3 TERMINATION AND WIRING

.1 Control schematics are shown for inter-wiring of the VFD and Field/Remote/Local devices.

.2 Control Wiring shall not be smaller than #14 AWG for control and instrumentation circuits. All instrumentation wiring pairs shall be individually shielded.

.3 All control wires to studs or similar device terminals on relays, indicating instruments, control switches, which are not equipped with terminal saddles shall be made with insulated locking fork lugs.

.4 Wiring shall be free from abrasion and tool marks and shall have a minimum bending radius of 11/4 inch and be of stranded type. A maximum of 12 stranded wires may be in a bundle to facilitate tracing of wires.

.5 Unsupported wiring on panels will not be permitted. Control wire bundles shall be formed in accordance with good wiring practices. Where cable bundles must be carried across hinges to devices mounted on doors, each cable or wire bundle shall be looped and carried between a clamp on the door and one on the fixed portion of the cabinet in such a manner that torsion and flexure in the loop shall be minimized. The cables shall be protected against abrasion with "spiral" or "snakeskin" protection material.

.6 Wiring between terminals of various devices shall be "point-to-point" (no splicing or tee connections of wire will be permitted), with wires neatly tucked along the back of the panels. Adequate support shall be provided to prevent sagging or damage from vibration in transit and operation.

.7 All control wires shall be provided with indelible permanent wire tags at each end of the wire. Numbering shall be via polyester or polyolefin heat-shrinkable sleeves. Marking shall be abrasion, ozone, ultraviolet, and solvent resistant. Numbering shall match control wiring diagrams.

.8 All power cables will enter the VFD via bottom fed cable. Cut-outs and gasketted removable cover plates shall be provided by the manufacturer to facilitate routing of cables installed in the field.

.9 Terminal blocks shall be provided for all control and instrumentation cabling entering or exiting the VFD. Each terminal block shall be clearly identified, and each point shall be marked. For stripping and bending of incoming cables, terminals shall be located at least 200 mm away from cable entrances and at least 300 mm above the floor. All terminals shall be segregated by voltage and service. Power leads shall be separated from control signals. Terminals shall allow the attachment of up to two (2) #14 AWG conductors without the use of ferrules or lugs. No more than two (2) conductors are permitted into a single terminal block point.

2.4 FUSES

.1 All control fuses shall be installed such that easy removal is possible without disconnecting the incoming power to the drive or the use of special tools (i.e. insulated fuse holders).

2.5 PANEL VENTILATION

.1 VFD panels shall have adequate ventilation. Fan shall be provided with the temperature switch adjusted to 25°C

.2

2.6 BUSSING

.1 All bus work shall be constructed of tin plated copper. Aluminum bus bars are not acceptable.

2.7 GENERAL LAYOUT AND ARRANGEMENTS

.1 The arrangement of equipment inside the VFD shall be such that rear access is not required.

.2 All indicators and control devices shall be accessible with the front door(s) closed.

2.8 FINISHING AND PAINTING

.1 Shop finish metal enclosed surfaces by application of rust resistant primer inside and outside, and at least two coats of finished enamel.

.2 Paint indoor enclosures light grey to EEMAC 2Y-1.

.3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

2.9 SPARE PARTS

.1 Spare parts to include the following:

.1 VFD Windows package including software, interface card, fibre optic converter and fibre optic kit.

Part 3 Execution

3.1 INSTALLATION

.1 Installation of the VFDs will be undertaken by the Contractor as per Drawing and Schematic and in accordance with manufacturer's specifications:

.1 Program the drive to the requirements of the specification and process narrative.
.2 Supply a table of program settings and values.

3.2 START-UP TESTING AND COMMISSIONING

.1 The Manufacturer will provide a start-up engineer for commissioning of the equipment after installation. Testing shall include but not be necessarily limited to:

.2 Contractor shall program the VFD parameters as per the existing sludge pump VFD parameters.

.1 Prior to performing any tests or applying power to the drives, it is the contractor=s responsibility to verify all cables and wiring connections as well as equipment setup and mounting arrangement (i.e. foundation, cable entry, etc.).
.2 Interfacing with the control system shall be verified and documented.
.3 During Testing verify the following but necessarily not limited to:
.1 Temperature
.2 Output frequency and voltage
.3 Proper function with control system
.4 All interlocks
.5 Contactors
.4 All equipment will be function tested, calibrated and load tested.

END OF SECTION

Part 1 General

1.1 PURPOSE

.1 This document provides the minimum performance criteria for the components and sub-systems comprising a complete cabling and enclosure system:

.1 Product specifications, quantities, general design considerations, and installation guidelines are provided herein, and shown on the Drawings. If the bid documents are in conflict, the written specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cabling system described in this document.

.2 Furnish all labor, supervision, tooling, miscellaneous mounting hardware.

.3 Installation of the cable and fusion splicing of the fibers at the fiber patch panels shall completed by a Corning Certified installer or a member of the cabling system manufacturer.

1.2 GENERAL

.1 This section applies to construction of control system communication networks.

.2 All network components of a single type shall be from the same manufacturer and the same manufacturer's catalogue number.

.3 All network sub-system components shall be from the same manufacturer.

1.3 SCOPE OF WORK

.1 Furnish and install complete with all accessories a Structured Cabling System (SCS) with enclosures and subsystem components to include cable, termination hardware, supporting hardware, and miscellany.

.2 The system shall utilize a network of fibre optic, and unshielded twisted pair, and station cables.

.3 Fibre cables shall terminate on fibre patch panels and/or modular patch panels located in all demarcation and termination points shown on the Drawings.

.4 All cables and terminations shall be identified at all locations.

.5 All cables shall terminate in an alphanumeric sequence at all termination locations.

.6 All copper cable terminations shall comply with, and be tested to ANSI/TIA/EIA 568-A standards for Category 6 installations.

.7 Work with general contractor to co-ordinate electrical power and conduit requirements. All electrical and conduit requirements for the structured cabling system described in this document are part of the scope of the structured cabling system. Co-ordinate with electrical specification for conduit installation details.

1.4 APPLICABLE DOCUMENTS & DRAWINGS

.1 TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard – 2008. All standards referenced within the TIA/EIA-568-B, where applicable, constitute standard provisions of this specification. Furthermore, compliance with the CEC will supersede all other Specifications.

.2 TIA/EIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces – October, 2004.

.3 TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings - May, 2002.

.4 TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications - August, 1994.

.5 Ontario Electrical Safety Code, Section 56 - Optic Fibre Cables, Section 60 - Communication.

.6 EIA/TIA 455-61 Measurement of Fibre or Cable Attenuation Using an OTDR.

.7 EIA/TIA 455-53A Standard Test Procedures for Fibre optic Fibres, Cables and Transducers, Sensors, Connecting and Terminating Devices, and other Fibre optic Components.

.8 If a conflict exists between applicable documents, then the order in the list above shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code and is therefore enforceable as law by a local, provincial, or federal inspection agency.

.9 If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed above are believed to be the most current releases of the documents; adhere to the most recent release when developing the proposal for installation.

1.5 SUBMITTALS

.1 Comply with Division 01, 26 and 40 requirements.

.2 Provide network wiring table spreadsheets in Excel format listing all structured cabling components and cabling source and destination connections for each fibre optic cable transmit and receive pair for backbone and horizontal cabling and each CAT6 horizontal cable and also include each fibre optic patch cord, each CAT6 patch cord for review.

.3 The documentation including testing results shall be submitted in both a printed format and an electronic version.

.4 Shop Drawings:

- .1 Submit Shop Drawings to the Engineer for review and approval containing quantities and product data sheets before ordering.
- .2 Provide manufacturer data sheets on all devices, modules, and subsystems of the proposed network communications systems. If data sheets show more than 1 product, the proposed product shall be clearly indicated by arrows or other suitable means. Data sheets shall be original manufacturer’s literature. Reproductions are not acceptable.
- .3 Provide grounding diagram showing grounding details for all enclosures and active network equipment.

.5 Test Documentation:

.1 Submit the Network – Cable Test Results Manual and Operations and Maintenance Manual 10 working days prior to the site acceptance test.

.2 Test results should be submitted in both an electronic and hard copy format.

.6 As-Built:

.1 Provide Shop Drawings to the Consultant at the conclusion of the project. The marked up drawing set will accurately depict the as-built status of the system including termination locations, cable routing, and all administration labeling for the cable system.

1.6 QUALIFICATIONS

.1 The contractor shall be Corning certified to install all required fiber optic cable, fusion splicing and installation of network equipment.

.2 The contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and Category 6 and fibre optic premise distribution systems.

.3 The contractor shall have personnel who are adequately trained in the usage of such tools and equipment.

Part 2 Products

2.1 ENCLOSURE WIRING

.1 The following general requirements shall be followed:

.1 All enclosure wiring shall run through a cable manager.

.2 Cable managers shall not be filled to more than 50% of their volume upon initial installation.

.3 All wires and cables, including spares, shall be identified at each end and at any connection.

.4 All field wires and cables terminated within enclosures shall be identified at each termination with a marking that corresponds with the supporting documentation.

.5 The enclosure shall include bend radius management for fiber patch cords and backbone cable.

.6 The enclosure shall support modular adaptor modules for multi-mode or single-mode fiber optic cables.

.7 Fiber slack trays shall attach to the rear of the modules providing slack storage and proper bend radius of fibers. The fiber slack trays and modules shall be front removable.

.8 Fiber colour and Tx/Rx orientation is to be identical for each termination panel.

.9 Dark fibers are to be covered to prevent damage.

2.2 FIBER OPTIC BACKBONE CABLING SYSTEM

.1 Each backbone cable runs radiating from the Main Plant PLC encloser to the remote I/O Control Panel(s) is considered as backbone and shall be labelled as such

.2 Work with Division 40 to co-ordinate installation and terminations of the cable runs after installation of the Remote I/O Control Panel.

.3 Fiber Optic Backbone Cabling System - Termination:

.1 The fiber optic cable shall be terminated at the Main Plant PLC Panel's rack mounted Fiber Patch Panels providing protection to the terminated fibers. When installing Multimode-mode fiber, SC connectors are to be fusion spliced to the backbone fiber cable and spliced are to be properly managed within fiber Patch panel / cassettes using appropriate splice kits. The SC connectors shall be a 50 μm, multi-mode connectors, capable of terminating either 250 μm coated or 900 μm buffered fibers. The connectors shall be field-installable, requiring no epoxy, or polishing. The connectors shall meet the intermateability requirements of TIA/EIA-604-12.

.2 The fiber optic cable shall be terminated at the Remote I/O/PLC Control panels In Fiber Patch panels/ enclosure providing protection to the terminated fibers. When installing Multimode-mode fiber, SC connectors are to be fusion spliced to the backbone fiber cable and spliced are to be properly managed within fiber Patch panel /enclosure using appropriate splice kits. SC multimode pigtail kits are to be dressed in the cartridges and installed in appropriate fiber panels.

.4 All fiber optic cables shall run/install in RPVC conduit.

2.3 FIBER OPTIC BACKBONE CABLE

.1 Provide fiber optic cable, connectors and appurtenances that make up the backbone cable segments.

.2 The fiber optic backbone cable segments shall meet the requirements of the TIA/EIA-568-A specification for 50 micron multi-mode fiber.

.3 All connectors for the termination of the fiber optic backbone cable shall be multi-mode SC connectors.

.4 Multi-Mode Fiber Optic Cable

.1 Multi-mode fiber optic backbone cable shall meet or exceed the following minimum requirements:

.1 Quantity 6 – 50 micron multi-mode fiber strands.

.2 Indoor/Outdoor Rating.

.3 Core-locked, Tight-buffered.

.4 Fifty (50) / 125 micron Core/Cladding for multi-mode fiber.

.5 Nine Hundred Fifty (950) MHz-km Bandwidth at 850 nm wavelength for multi-mode fiber.

.6 Five Hundred (500) MHz-km Bandwidth at 1,300 nm wavelength for multi-mode fiber.

.7 OM4.

.8 Riser-Rated (FT4) inner and outer PVC jackets.

.9 Gel-free Cable.

.2 The multi-mode fiber optic cable shall be manufactured by Corning. Part Number: 006TSF-T4190D20. or approved equal

.5 Multi-Mode Fiber Optic Cable (Patch cord)

.1 Multi-mode fiber optic patch cables shall meet or exceed the following minimum requirements:

.1 2 fiber strands.

.2 50 micron multi-mode (OM4)

.3 SC Duplex to SC Duplex connectors

.4 Tight-Buffered Cable

.5 Length 1 m

.6 Indoor Rated

.2 The multi-mode fiber optic cable shall be manufactured by Corning. Part Number: 575702Q5120001M. or approved equal

.3 Provide 2 spares patch cables in each panel.

2.4 HORIZONTAL CABLING SYSTEM

.1 Horizontal Cable:

.1 Provide twisted-pair cable, connectors and appurtenances that make up the Horizontal cables segments.

.2 Horizontal cable segments shall meet the requirements of the TIA/EIA-568-A specification for Category 6 (CAT6), Unshielded Twisted Pair (UTP) cable.

.3 Horizontal Cable Segments shall meet or exceed the following minimum requirements:

.1 The cable shall be tested up to 200 MHz with a guaranteed performance that meets or exceeds the ANSI/TIA/EIA-568B/ISO/IEC 11801 horizontal cable requirements for PS-NEXT, attenuation, structural return loss, and attenuation-to-crosstalk ratio (ACR).

.2 The cable shall be constructed from 0.54 mm (24AWG), bare copper wire insulated. Two (2) insulated conductors twisted together to form a pair and 4 pairs laid up to form the basic unit.

.3 The cable shall be jacketed in flame-retardant PVC. Cable run in conduit shall meet or exceed FT4 rating. Cable not run in conduit shall meet or exceed FT6 rating.

.4 Horizontal cable not run in conduit shall be FT6 rated.

.2 Enclosure Wiring:

.1 All enclosure wiring shall run through a cable manager.

.2 Cable managers shall not be filled to more than 50% of their volume upon initial installation.

.3 All wires and cables, including spares, shall be identified at each end and at any connection. Use durable non-fading sleeve type wire markers to identify network cables as follows:

.1 Labels for cabling shall be laser printed, self-laminating, adhesive, polyester (indoor/outdoor).

.2 Hand-written labels will not be accepted.

.3 Lettering shall be black on a white background. Characters shall be a minimum of 4 mm high.

.4 Wire markers are required on each conductor in panel board gutters, and at load connections. The identification shall include branch circuit or feeder number for power and lighting circuits, and control wire numbers for control wiring.

.5 All field wires and cables terminated within enclosures shall be identified at each termination with a marking that corresponds with the Drawings and supporting documentation.

Part 3 Execution

3.1 CABLE INSTALLATION SPECIFICATIONS

.1 All installation work shall comply with the latest version of the applicable Codes, Standards, and Regulations of authorities having jurisdiction. In particular, EIA/TIA 568-A standards and Corning's Design and Installation guidelines shall be followed.

.2 The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines will require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

.3 The contractor shall provide any special equipment or tools necessary to properly perform the cable installation.

.4 Provide a complete and operational system, all components and appurtenances necessary to ensure that the network connection is functional and meet the intent of this Specification.

.5 Backbone:

.1 Contractor shall supply and install the transmission media and terminating hardware to provide interconnection between the Main plant PLC Panel and Remote I/O PLC panel(as detailed in the contract documents.

.2 All fibres will be run in conduit and terminate in the panels (shown in the contract document) equipped with sufficient panels, couplers and jumper storage shelves to terminate and secure all fibres.

.3 Adequate conduit space will be available in all Panels such that no drilling is necessary.

.4 Contractor shall observe the bending radius and pulling strength requirements of all backbone cables during handling and installation.

.6 Enclosure Termination:

.1 Termination:

.1 All data cables shall be terminated and bundled in an organized manner in the enclosure on properly mounted Fiber Patch Panels.

.2 Data cable ends shall be labeled according to the Tagging conventions specified in this section

.3 Patch cables shall be bundled in a neat and organized manner.

.2 Workmanship:

.1 Components of the Structured Cabling System shall be installed in a neat, workmanlike manner.

.2 Wiring color codes shall be strictly observed, and terminations shall be uniform throughout the system.

.3 Identification markings and systems shall be uniform.

.4 ANSI/TIA/EIA 568-A wiring codes shall standardize all Structured Cabling System wiring.

.3 Miscellaneous Equipment:

.1 The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, wire moulding, miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the System.

.4 Special Equipment and Tools:

.1 It shall be the responsibility of the Contractor to furnish any special installation equipment or tools necessary to properly complete the System.

3.2 TAGGING CONVENTION STANDARD

.1 General:

.1 The requirements of this Section will take precedence over other Sections, with respect to network component identification.

.2 The codification of network components, cables and cable routing shall follow the identification standards detailed in this Specification Section.

.2 UTP and Fibre Patch Panels:

.1 Labels for patch panels shall be laser printed, self-laminating, adhesive, polyester, or polyolefin. Hand-written labels will not be accepted.

.2 Lettering shall be black on a white background. Characters are a minimum of 6 mm high.

.3 Labels shall be applied to patch panels in such a manner as to be readily visible and not obscured by structured cabling or patch cords.

.4 The tagging convention for patch panels will employ a four character alphanumeric tag. The first 2 characters will indicate the type of patch panel. The second 2 characters will be a unique index within each enclosure starting from the top. The characters “CP” will denote Copper Ethernet Patch Panels. The characters “FP” will denote Fibre Patch Panels.

.3 Fibre Optic Patch Panel Termination Point:

.1 Terminate all strands of each fibre optic cable.

.2 The ordering and colour of individual fibres will be the same for each fibre cable and compliant with TIA/EIA-568-A.

.3 Labels shall be laser printed, self-laminating, adhesive, polyester, or polyolefin. Hand-written labels will not be accepted.

.4 Lettering shall be black on a white background. Characters are a minimum of 4 mm high.

.5 A label shall be applied to the top of each fibre adapter panel module associated with a single fibre cable indicating the destination of the cable. The cable destination shall be the PLC Control Panel tag name.

.4 Network Cable Identification:

.1 Use durable non-fading sleeve type wire markers to identify network cables.

.2 Labels for cabling shall be laser printed, self-laminating, adhesive, polyester (indoor/outdoor). Hand-written labels will not be accepted.

.3 Lettering shall be black on a white background. Characters shall be a minimum of 4 mm in height.

.5 Fibre Optic Backbone Cables:

.1 As a minimum, fibre optic backbone cables are to be labeled at both ends of the cable.

.2 In addition, the fibre backbone cables are to be labeled at each transition. A transition is defined as: A change in ducting (e.g. cable tray to conduit), a change in direction of more than 45°, or an entrance and exit of ducting through a wall or floor.

.3 If a single fibre cable is run in conduit then the transition labels shall be applied to the conduit.

.4 If multiple fibre cables are run in the same conduit then the transition labels shall be applied to the individual fibre cables.

.5 The tagging convention for identification of fiber optic backbone cables shall indicate the source and destination of the cable separated by a colon. For example, a fiber optic backbone cable whose source is PLC Control Panel 1, Fiber Patch Panel #1 and terminates in PLC Control Panel 2, Fiber Patch Panel #1 would have the following tag:

PLC01-FP01 : PLC02-FP01

.6 Horizontal Cables:

.1 As a minimum, horizontal CAT6 cable is to be labeled at both ends of the cable.

.7 Patch Cords:

.1 No labels are required on copper or fibre patch cords.

.8 Cable Routing:

.1 All ducting (cable tray or conduit) carrying fibre optic backbone cable shall be tagged as “LAN BACKBONE”. Labels shall be applied on the conduit every 6 m, on either side of a wall pass through or on either side of a bend of 45° or greater.

.2 All ducting carrying Horizontal cables shall be tagged as “LAN”. Labels shall be applied on the conduit every 6 m, on either side of a wall pass through or on either side of a bend of 45° or greater.

.3 Labels should be black lettering on white background. Letters should be 22 mm in height. Label are to be orientated so they can easily be read from the ground.

3.3 TESTING AND INSPECTION

.1 General:

.1 All terminated data cables shall be tested.

.2 Tests shall include conformance to EIA/TIA 568-A Category 6 specifications

.3 The contractor shall be responsible for bringing any cable not meeting requirements into compliance at no cost to the Owner.

.4 At the completion of each phase the contractor and the Engineer shall jointly inspect the work for completeness, consistency, and conformance to required standards. The following points in particular shall be examined:

.1 That all labeling of cables and work area outlets meet Specifications.

.2 That all cables are properly routed and supported.

.3 That all cables are tested and meet Specifications.

.4 That all terminations meet Specifications.

.2 Cable System Testing – Copper:

.1 Category 6 horizontal cables shall be tested according to test set manufacturer's instructions utilizing the latest firmware and software.

.2 Complete, end to end, test results must be submitted to the Engineer.

.3 Horizontal wiring pairs shall be tested from the end point to the Core Server Enclosure.

.4 Testing of all copper wiring shall be performed prior to system cutover. All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. All conductors of each installed cable shall be verified usable prior to system acceptance. Any defect in the cable system installation including but not limited to cable, connectors, feed-through couplers, patch panels, splices, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed. The Category 6 cable runs shall be tested for conformance to the specifications of EIA/TIA 568-A Category 6.

.5 All cables shall be tested in accordance with this document and best industry practices.

.6 One Hundred (100) % of the horizontal wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage. These cables shall be tested using a Class II cable analyzer.

.7 Each pair of each installed cable shall be tested using a "green light" test set that shows opens, shorts, polarity and pair-reversals. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

.8 Length: Each installed cable shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block,

patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-A Standard.

.9 Performance Verification: Enhanced Category 6 unshielded twisted pair (UTP) data cable shall be performance verified using an automated test set. This test shall be conducted from the patch panel or wiring block to the outlet (installed link). The test shall include checks for continuity and length as defined above and the following:

.1 Bi-directional Near End Cross-Talk (NEXT).

.2 Attenuation to Cross-Talk Ratio (ACR).

.10 Test equipment must be capable of certifying Category 6 to TIA-568-C.2 standards.

.11 Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test result and the actual test result achieved. Use test software to organize test results and provide results that are compatible with the label software.

.12 Category 6 (UTP) Documentation: As a minimum, test reports shall include the following information for each UTP CAT6 cabling element tested:

.1 Length (in metres), propagation delay, and delay skew relative to the relevant limit.

.2 Any individual test that fails the relevant performance specification shall be marked as a FAIL.

.3 Cable manufacturer, cable model number/type, and NVP.

.4 Tester, manufacturer, model, serial number, hardware version, and software version.

.5 Circuit ID number (Cable Tag Id) and Facility (Plant).

.6 Test criteria used.

.7 Overall pass/fail indication.

.8 Date and Time of test.

.13 All test equipment of a given type shall be recently (within 1 yr) calibrated from the same manufacturer, and have compatible electronic results output with up to date test limits and version limits. Acceptable test equipment manufacturer is Fluke Networks DTX 1800 Cable Analyzer.

.3 Cable System Testing – Fibre Optic:

.1 All fibre testing shall be performed on all fibres in the completed end-to-end system. Testing of all fibre optic cable shall be performed prior to system cutover. All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. All conductors of each installed cable shall be verified usable prior to system acceptance. Any defect in the cable system installation including but not limited to cable, connectors, feed-through couplers, patch panels, splices, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

.2 Testing shall consist of a bi-directional end to end OTDR trace performed per EIA/TIA 455-61 and a bi-directional end to end power meter test performed per EIA/TIA 455-53A.

.3 The system loss measurements shall be provided at 850 and 1,300 nanometers for multimode fibres.

.4 Pre-installation cable testing:

.1 The Contractor shall test all light guide cable prior to the installation of the cable.

.2 The Contractor shall assume all liability for the replacement of the cable should it be found defective at a later date.

.5 All fiber terminations shall be visually inspected with a minimum 100 X microscope to ensure that no surface imperfections exist after final polishing. In addition, each fibre strand shall be tested for attenuation with an optical power meter and light source.

.6 Multimode Fibre Testing: Horizontal distribution multimode optical fibre attenuation shall be measured in 1 direction at either 850 nanometers (nm) or 1,300 nm using an LED light source and power meter. Backbone multimode fibre shall be tested at both 850 nm and 1,300 nm in 1 direction. Test set-up and performance shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, Method B. One 2 m patch cord shall be used for the test reference and two 2 m patch cords shall be used for the actual test. This test method uses a one-jumper reference, two-jumper test to estimate the actual link loss of the installed cables plus the loss of 2 connectors.

.7 Fibre Optic Documentation. As a minimum, test reports shall include the following information for each fibre optic cabling element (fibre) tested:

.1 Actual measured attenuation, maximum allowable attenuation (loss) and the attenuation margin at the specified wavelengths. An individual test that fails the link criteria shall be marked as FAIL.

.2 Reference method.

.3 Number of mated connectors.

.4 Actual length and maximum allowable length. Any individual test that fails the link length criteria shall be marked as FAIL.

.5 Group refractive index (GRI) for the type of fibre tested, if length was optically measured.

.6 Tester manufacturer, model, serial number and software version.

.7 Circuit ID number (Cable Tag ID) and facility (Plant).

.8 Link criteria used.

.9 Overall pass/fail indication.

.10 Date and time of test.

.8 Backbone multimode fibre cabling shall be tested at both 850 nm and 1,300 nm bi-directional using VCSEL light source and GFM2 Fluke Fibre Module.

.9 Acceptable test equipment manufacturer is Fluke Networks DTX 1,800 Cable Analyzer.

.10 Test results must be submitted in 2 formats. First, must be original file(s) downloaded from the tester.

3.4 TEST DOCUMENTATION

.1 Test documentation shall be provided in an electronic format from the network tester as well as hard copies u separate from all other contract documentation within 3 weeks after substantial completion of the project.

3.5 FIRESTOP SYSTEMS

.1 A firestop system is comprised of: The item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, heat, vapour and pressurized water stream.

.2 All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through 1 side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped.

.3 Firestop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the province where the work is to be performed.

.4 All firestop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance.

3.6 PENETRATIONS OF WALLS, FLOORS AND CEILINGS

.1 Prior consent:

.1 The Contractor shall make no penetration of floors, walls or ceiling without the prior consent of the Engineer and General Contractor.

.2 Sealing penetrations:

.1 Where penetrations through acoustical walls or other walls for cableways have been provided for the Contractor or made by the Contractor, such penetrations shall be sealed by the Contractor in compliance with applicable code requirements and as directed by the Engineer or General Contractor.

.2 Where penetrations through fire-rated walls for cableways have been provided for the Contractor or made by the Contractor, the Contractor shall seal such penetrations as required by code and as directed by the Engineer or General Contractor.

3.7 WARRANTY AND SERVICES

.1 General:

.1 Provide a warranty covering the installed cable system against defects in workmanship, components, and performance, and follow-on support after project completion.

.2 Warranty Documentation:

.1 Complete documentation regarding the manufacturer's warranty including documentation of the support procedure for warranty issues shall be submitted when the installation is complete.

3.8 DAMAGES

.1 The contractor shall be held responsible for all damages to the building or building systems caused by its employees or subcontractors

.2 It shall be the responsibility of the contractor to notify the Owner's Representative when damages have occurred and to make the necessary arrangements for the prompt repair of these damages.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International):

.1 CSA C22.2 No. 100, Motors and Generators.

.2 CSA C22.2 No. 145, Motors and Generators for Use in Hazardous Locations.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC):

.1 EEMAC M1-7, Standard for Motors and Generators.

.2 EEMAC M2-1, Standard for Lead Marking and Connections for Single-Phase and Polyphase Induction Motors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: In accordance with Document 01 33 00 – Submittal Procedures and Document 26 05 00 – Common Work Results for Electrical.

.2 Shop Drawings:

.1 Submit Drawings stamped and signed by professional engineer licensed in Ontario.

.2 Indicate:

.1 Overall dimensions of motor.

.2 Shaft centreline to base dimension.

.3 Shaft extension diameter and keyway, coupling dimensions and details.

.4 Fixing support dimensions.

.5 Dimensioned position of ventilation openings. Details of ventilation duct attachments.

.6 Terminal box location and size of terminals.

.7 Arrangement and dimensions of accessories.

.8 Diagram of connections.

.9 Starting current and relative data necessary for use in design of motor starting equipment.

.10 Speed/torque characteristic.

.11 Weight.

.12 Installation data.

.13 Shop test report of motor operation.

.3 Closeout Submittals:

.1 Provide maintenance data for motors for incorporation into manual specified in Document 01 78 23 – Operating and Maintenance Data and Document 26 05 00 – Common Work Results for Electrical.

.2 Data necessary for maintenance of motors.

.3 Manufacturer's recommended list of spare parts.

.4 Quality Assurance:

.1 Engineer reserves the right to witness standard factory testing of motors 50 hp and above.

.2 Submit site tests results of installed electrical systems and instrumentation.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, handle and protect materials in accordance with Division 01.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Handle motors with suitable lifting equipment.

.4 Store motors in heated, dry, weather-protected enclosure.

1.4 EXTRA MATERIALS

.1 Provide maintenance materials and spare parts in accordance Document 01 78 23 – Operating and Maintenance Data.

Part 2 Products

2.1 MATERIALS

.1 Motors:

.1 Non-hazardous locations: To CSA C22.2 No. 100.

.2 Hazardous locations: To CSA C22.2 No. 145.

.2 Lead markings: To EEMAC M2-1.

2.2 CORROSION PREVENTION AND FINISH PAINTING

.1 Provide equipment resistant to corrosion from severe moisture conditions.

2.3 RATING

.1 Motor: This shall be like for Like replacement

.1 Single speed: hp, sized as required.

.2 Two speed: hp, sized as required.

.3 600 V, 3-phase, 60 Hz, or as required.

.4 Frame size: To industry and NEMA MG1 standards.

.5 Enclosure: TEFC, fully guarded and rated for the area.

.6 Operation: As required by equipment manufacturer.

.2 Preferred Part No

.1 Sludge Pumps: **HT020506NPW22 20Hp motor (1 required)**

.2 **Supernatant Pump: HT007508NPW22 7.5Hp motor (2 required)**

2.4 MOTOR TYPE

.1 Squirrel cage or wound rotor induction, as required and approved by the Engineer.

.2 Motors utilizing VFDs are to be inverter duty rated in accordance with NEMA MG1 MG1.

2.5 DESIGN LETTERS

.1 Polyphase squirrel cage induction motors design B.

2.6 ENCLOSURE

.1 Totally enclosed fan cooled.

.2 Totally enclosed explosion proof for use in: Class 1 Zone 1 group IIa/b hazardous location or Class 1 Zone 2 Group IIa/b (where applicable).

2.7 SERVICE CONDITIONS

.1 Suitable for use in the environment and process.

2.8 APPLICATION

.1 Motor suitable for driving supplier equipment.

2.9 PERFORMANCE CHARACTERISTICS

.1 Efficiency: Premium efficiency.

.2 Service factor:

.1 1.00 for inverter duty.

.2 1.15 for all others.

.3 Time rating: Continuous or intermittent duty (per supplier’s standard product).

2.10 INSULATION

.1 Class: F.

.2 Ambient temperature: 40° C.

.3 Temperature rise: Class B.

2.11 THERMAL PROTECTION

.1 Factory installed thermal protection in each phase, wired to identified terminals in motor terminal box (if requested in equipment supply).

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or Specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Dry out motor if dampness present in accordance with manufacturer's instructions.

.2 Install motor rigid plumb and square, using only lifting facilities provided.

.3 Make wiring connections:

.1 Use liquid tight PVC jacketed flexible conduit between rigid conduit and motor.

.4 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.

.5 Check for correct direction of rotation, with motor uncoupled from driven equipment.

.6 Align and couple motor to driven machinery to manufacturer's instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

3.3 FACTORY ACCEPTANCE TESTING

.1 Perform tests in accordance with Division 01 and Division 26.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 The general requirements for the supply and installation of all process control equipment as specified herein and as shown in the Drawings are covered in this Specification Section.

.2 Comply with the requirements of Division 01, 26 and Division 40.

.3 Refer to Division 20, 26 and 40 for additional requirements.

.4 Refer to the Contract Drawings to ensure completeness of installation for all items and that these items are compatible with the control and operational intent of the design of this project.

.5 Without limitation to the following sections of this division, the equipment supplied shall be complete with all accessory items, whether specifically mentioned or not, so as to provide completeness of installation, controls and operation as intended. All equipment installation shall be as recommended by the equipment manufacturer or as described in the Installation Drawing.

.6 Provide all necessary equipment, tools, labour, etc., for installing and testing all equipment supplied under this Division.

.7 Modify and/or remove existing equipment as shown on the Contract Drawings.

.8 Supply install and commission all equipment and instrumentation detailed in the Drawings.

.9 Supply, install and setup all network equipment shown in the contract documents.

.10 Without limitation to the following sections of this division, the equipment supplied shall be complete with all accessory items, whether specifically mentioned or not, so as to provide completeness of installation, controls and operation as intended. All equipment installation shall be as recommended by the equipment manufacturer or as described in the Installation Drawing. Contractor shall calibrate all instrumentation whether new or reused, by manufacturer certified technicians.

.11 Update the Existing SCADA Manual and any other SCADA documentation to include the integration of new equipment shown in the contract documents (Including updates to I/O lists, Control Panel Drawings, Network Drawings, etc.).

.12 Review and ensure that PLC programming, documentation development, testing and commissioning tasks developed meets Division 40 requirements and Owner's standards prior to submission to the Engineer for review.

.13 PLC and SCADA programming shall comply with Owner's standard programming templates. Plant System Integrator with approval from the Engineer shall modify the

standard PCS modules to suit and accommodate all tagging and functionality required by the Contract Documents.

.14 Lead and conduct 2 workshops (each workshop minimum 4 hrs) with Engineer, and Plant staff, to finalize Plant Process Control Narratives (including Alarm conditioning, alarm priority, overall operation of equipment and overall integration with existing upstream and downstream equipment/systems, before programming can commence. Update plant PCNs to reflect updates discussed during workshops and submit for final draft review before programming starts.

.15 Configure required new and existing network equipment to properly integrate new equipment into the plant network system. Update network associated documentation to identify and record updates to hardware, IP addresses, port assignment, and any associated changes to the configuration based on the new equipment installed.

.16 Update PCN to include system operation and integration with overall process (including updates to associated process operation, tables, process setpoints, alarming, interlocks, etc.).

.17 Develop Testing and commissioning documentation to ensure the proper operation of the equipment and its integration into the pant operation.

1.2 PLANT SCADA SYSTEM INTEGRATION SERVICES

.1 Plant System integrator shall update existing PLC logic, SCADA system, historian, and reporting as well as existing associated documentation to reflect upgrades/changes to the system based on the scope of work detailed in the contract documents (Updates include but not limited to PLC logic, data messaged between PLCs, SCADA database, PCNs, I/O lists, SCADA manual, reports, Control Panel drawing, etc..)

.2 Plant System integrator shall integrate all new equipment/signals connected to the new PLC Control Panel(s) (as shown in the contract documents) (integration services include PLC programming, SCADA system programming, historian, reporting and all associated documentation.)

.3 Plant System integrator shall communicate critical data between PLCs for the proper operation of the overall system.

.4 Plant System Integrator shall coordinate and lead the complete system software FAT in order to test the proper operation and functionality of the overall system. Software FAT shall test PLC, SCADA system as a whole system and not as separate pieces.

.5 Plant System Integrator shall host 2 separate alarm conditioning workshops with the Owner and Engineer to review alarm conditioning and alarm prioritization. All alarm conditioning details shall be finalized and documented in the final PCN.

.6 Plant System Integrator shall be responsible for reviewing any programming standards and ensure that PPC and SCADA programming, PCN, SCADA manual and any other SCADA associated documentation complies with Owner’s standards before documentation is submitted for review of the engineer.

1.3 SUBMITTALS

.1 Comply with the requirements of Division 1 General Requirements, Submittal Procedures Section. Instrument submittal requirements are in Specification Section 40 70 10 - Instrumentation - General.

.2 Shop Drawings must be submitted and reviewed for all equipment in Division 40, before ordering or fabrication.

.3 Provide a complete listing of recommended supplies for each type of supplied equipment.

1.4 PROJECT COORDINATION

.1 Comply with the requirements of Division 01.

1.5 STANDARDS

.1 All equipment and workmanship shall conform to the applicable standards established by ASTM, CEC (including Ontario Supplement), OESC (Ontario Electrical Safety Code), CGSB, CSA and Hydro One. Where conflicting standards occur, the more stringent standard shall be applied

.2 All field devices and control panels shall be rated for the electrical classification of the area in which they are installed, and rated for NEMA 4 service unless otherwise noted. Refer to area electrical classification Drawings. Corrosion resistant materials and panels shall be used in areas subject to a corrosive environment.

1.6 GENERAL REQUIREMENTS

.1 Provide all supplies used during and prior to acceptance of equipment. In addition, provide an estimated one year's supply of materials necessary for normal operation and scheduled maintenance of all equipment.

.2 Supplies shall be furnished in the original sealed containers, correctly identified as to brand and grade, and with reference to the particular piece of equipment for which it is intended.

.3 Please see the individual equipment Specifications for details on required supplies.

.4 The equipment specified shall generally be an "all electronic" control system, with 4-20 mA DC linear outputs from all instruments, unless otherwise noted. Equipment shall be suitable for 120 VAC, 60 Hz, single phase operation, or 24 VDC operation as shown on the Drawings.

.5 Supply and install all required current isolators, signal conditioners, etc., (may not be shown), for the entire control and instrumentation system to operate as intended.

.6 All instrument components shall have ample margin to withstand transient and other surge voltages which may occur, including transient periods under change over conditions.

.7 All equipment mounted outdoors shall be installed in NEMA 4X enclosures, with heaters, and be suitable for operating in temperatures from -40° to +65° C.

.8 All instrument local indicators shall be in metric engineering units unless specified otherwise.

.9 All panels and instruments shall be complete with factory applied finishes. Repaint all damaged factory applied finishes.

.10 All panels installed outdoors and exposed to the public shall have the exposed surface coated with an anti-graffiti coating.

.11 Locations of instrumentation provided in contract documents are approximate. Final instrument location and installation shall be coordinated with site inspector or engineer. Contractor shall install instrumentation to best fit the application.

.12 The successful system integrator shall possess software licenses for all programming, testing, and commissioning purposes.

.13 Contractor and System Integrator shall coordinate with plant operation to develop and submit a Transition Plan or Work Plan for Plant Operation and PCS Staff to review and approve before starting the work of PLC/SCADA upgrades, in terms of shutdown items, dates, duration, temporary monitoring, and operation methods.

.14 Contractor shall install and wire all vendor supplied equipment as well as free issued equipment provided by the owner. Contractor shall install and wire all equipment identified and non-identified from the vendor supplied equipment listed in the Contract Drawings.

.15 Contractor shall coordinate with the vendor supplied systems to properly install and wire the supplied systems.

.16 Contractor shall coordinate with the other Divisions to properly install, wire and commission the provided systems/equipment to ensure the systems function as designed and intended.

.17 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.
.2 Data Sheets.
.3 Preliminary issue of operating and maintenance instruction manual.
.4 Panel inspection and factory acceptance testing (FAT).
.5 Signed calibration sheet or report on each field instrument.
.6 Report on proper site installation, inspection, and loop checks.
.7 Final submission and sign-off of Product Data Sheets.
.8 Site Acceptance Testing (SAT).
.9 Maintenance training sessions on field instruments.

.10 Training.

.18 Conduct Factory Acceptance Test (FAT) to demonstrate the operational functionality of PLCs, SCADA hardware, software and communications. Notify the Engineer 10 days in advance of FAT such that this test may be witnessed by the appropriate parties. Submit test report after the test duly signed by the Engineer and Contractor. Use only pre-approved test format. Comply with the Owner's Standards for FAT requirements.

.19 Conduct Site Acceptance Test (SAT) to demonstrate the correct operation of control system with both hardware and software in place. Provide site support services upon request by System Integrator during system SAT. Notify the Engineer 10 days in advance of SAT such that this test may be witnessed by the appropriate parties. Submit filled in test forms after commissioning. Comply with the Owner's standards for SAT requirements.

.20 Coordinate closely with the Engineer, owner, subcontractors and System integrator when carrying out all work to demonstrate overall system integrity, allowing sufficient time for the essential portions of SCADA and PLC software to be installed and tested.

.21 Demonstrate loop checks for the I/O identified by this scope of work. Before requesting witnessed loop checks, carry out Contractor's own field and loop check tests to verify that the equipment operates as intended. Correct any problems or deficiencies prior to requesting witnessed checks.

.22 On site loop check must exercise the entire loop, including the field equipment and SCADA screens. Each loop check must be witnessed by, and successfully demonstrated to the Engineer for sign-off approval.

.23 Installation of fiber optic cable shall comply with Section 56 (Optical Fiber Cables) of the Ontario Electric Safety Code and the ANSI/TIA-568-C Telecommunications Building Standard or latest version. Installation of fiber optic cables shall be completed by a manufacture's certified installer.

.24 Without limitation to the following sections of this division, the equipment supplied shall be completed with all accessory items, whether specifically mentioned or not, so as to provide completeness of installation, controls and operation as intended. All equipment installation shall be as recommended by the equipment manufacturer or as described in the Installation Drawing.

.25 Fiber Optics installation and termination (Fusion Splice) shall be done by the manufacturer certified technician.

.26 Provide and install new field wiring to/from the Vendor control panels to the associated vendor equipment as shown in the Contract Drawings. If additional equipment is provided by the vendor systems and it is not detailed in the contract documents, contractor shall install and wire the additional equipment without extra cost to the owner.

.27 Provide and install new field wiring for all instrumentation connected to the Control Panels as detailed in the Contract Documents.

.28 Contractor shall coordinate with selected Vendor Package System providers and equipment manufactures to provide all required wiring, connections and proper operation of the vendor system.

.29 Record Drawings:

.1 Provide final as constructed Record Drawings for control panels supplied or retrofitted. All retrofit works shall be clearly detailed.

.2 Operation and maintenance documentation for each type instrument after product approval.

.3 Calibration certifications from the manufacturer for each calibrated instrument.

.4 Provide electronic configuration file for all smart instruments.

.5 For the new control panels submit all control panel Record Drawings in editable CAD format in accordance with the Owner's CAD Standards and utilizing all Owner's CAD templates in the Owner's standards.

.6 For all retrofitted control panels with existing CAD files, submit updated CAD files utilizing the existing CAD files as a starting point. If no CAD files were supplied, Contractor shall prepare new CAD files in accordance with the Owner's CAD Standards.

.7 Provide Filed Instrument and Instrument Manual. Provide equipment and instrument descriptions, with the following information for each model piece of equipment and instrument supplied and installed:

.1 Manufacturer's design and performance specification data and descriptive literature.

.2 Equipment dimensions, installation requirements, typical mounting details showing methods and materials required for installation and recommendations.

.3 Required and optional accessories list.

.4 List of recommended spare parts and spare parts provided.

.5 Electrical/pneumatic signal and power connection diagrams.

.6 Operation and maintenance manuals.

.7 Provide a written narrative describing the operating parameters, product maintenance requirements, performance limitations, warranty requirements, and recommended inspection requirements.

.8 Provide As-Built Instrument Data Sheets.

.9 Each instrument will be listed and pertinent information recorded including: Tag number and description, complete model number, ranges, setpoints, materials and special mounting details for non-typical applications.

.10 The data sheets will be based on ISA Standard – S20: Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

.11 Provide calibration certifications from the manufacturer for each instrument calibrated prior to installation.

.8 Provide updated Shop Drawings for all mounting fixtures.

.9 SCADA User Manual: The System Integrator to provide the SCADA Operations Manuals. The purpose of the SCADA User Manual is to provide operators an understanding of the human-machine interface (HMI) features designed in the SCADA system. This ensures that authorized plant personnel will be able to control, monitor and access historical information, as per Contract Specification. Its primary focus is on the HMI features, such as, screen navigation, interpreting graphic symbols behavior, graphics display information and alarm messages, acknowledging of alarms, changing of control set points, and other SCADA functions should include, but not be limited to:

.1 General overview of the system.

.2 SCADA Navigation and Features.

.3 SCADA Overview Screens.

.4 Instructions on the use of HMI (Human-Machine Interface) Buttons or similar interactive features.

.5 Pop-up (Sub-picture) Screens.

.6 Process Specific Screens.

.7 SCADA Diagnostics and Support.

.8 Alarm Screens.

.9 Trend Screens.

.10 PLC and SCADA Software: The final documentation shall include all documentation on the software programs and settings, without hidden sections or password protection, in order that Owner can fully troubleshoot problems and download the backup copy of the grogram when needed. Providing the complete documentation by the System Integrator shall not reduce the System Integrator's warranty obligations.

1.7 SUPPLEMENTS

END OF SECTION

Part 1 General

1.1 GENERAL

.1 The Software Factory Acceptance Test (FAT) demonstrates that all SCADA and controller software are working properly and that all software configurations match the requirements identified in Detailed Software Design, including the detailed process narratives.

.2 Test the software under all possible process conditions in order to ensure the software contains no defects. Include a wide range of operating scenarios, with all process setpoints, interlocks and alarm limits.

1.2 OBJECTIVES

.1 The overall objectives of the Factory Acceptance Test are to:

.1 Confirm and document that the PLC I/O matches the type and quantity identified in the control schematics. Perform I/O checks to confirm the tag number.

.2 Confirm and document that the individual device logic operates all field equipment correctly and safely, as described in the detailed process narrative, and HMI and SCADA functionality.

.3 Confirm and document that the software is fully integrated into the treatment process and plant/facility-wide control logic and operates correctly and safely, through the HMI as described in the detailed process narratives.

.4 Confirm and document that the data to be integrated into the Plant SCADA system, historian and reports is correct and matches the data described/listed in the Process Control Narratives.

1.3 SUBMITTALS

.1 The following submittals are made during the FAT procedure:

.1 Submit the test plan: Testing forms, procedures and schedules of work, not less than 2 weeks prior to the scheduled test date.

.2 Submit copies of the PLC program, HMI graphics, OIT graphics, SCADA database. Copies shall be provided in PDF format to provide markups as well as the files in their native format.

.3 Submit copies of the updated Process Control Narratives, P&IDs and I/O Lists.

.4 Submit testing documentation including all testing scenarios to be undertaken.

.5 The test plan must be reviewed by the Engineer, prior to commencement.

.6 Factory Acceptance Test Report shall be submitted within 1 week after completion of FAT.

.7 Once the FAT has been completed, it is assumed that there will be no modifications to any software to be integrated into the plant SCADA and PLC system.

.8 Once Panel FAT has been completed, it is assumed that there will be no modifications. Only modifications to the address comments/deficiencies noted during the Panel FAT are to be completed. All deficiencies shall be addressed before shipping to site.

1.4 TESTING PROCESS

.1 The System Integrator shall conduct the tests. Owner representative and the Engineer will actively participate in the tests. The Owner representative and Engineer reserves the right to test any specified hardware/ software function whether or not explicitly stated in the test submittal.

.2 The System Integrator is to invite the following representatives of the following groups to attend the FAT:

.1 Facility Operations/Process End Users.

.2 Engineer.

.3 The System Integrator should meet the following criteria prior to the start of the tests:

.1 Complete submittals and resolve disputes.

.2 Make hardware and software fully operational.

.3 Have both, the Owner representative and Engineer review and approve test procedure.

.4 The FAT may be repeated as many times as required until the Engineer and Owner has deemed the final software product to be satisfactory to progressing to field implementation and the Site Acceptance Testing.

.5 Representatives of the System Integrator, Owner and Engineer shall sign a FAT Sign-Off form to indicate completion of the tests. A deficiency list shall be submitted indicating required changes including a schedule for completion.

1.5 TESTING DOCUMENTATION

.1 Prepare Factory Acceptance Test and Site Acceptance based on the Owner's FAT and SAT template Testing document (Attached for information only). System Integrator shall develop the specific testing procedure based on the specific equipment, their operation and functionality of the system under test. System Integrator should request document in its original format) showing the following information as a minimum:

.1 For all I/O points list the device tag name, PLC tag name, Description of point, I/O Address (if applicable), Date Verified, Comments and Issue Log Number.

.2 For field inputs and outputs also list, Device Range (Minimum, Maximum and Units), HMI Device Range (Minimum, Maximum and Units) and HMI Engineering Units Test (Minimum, Mid-range and Maximum).

.3 For analog input alarms list the Trip point for the alarm in percent of span, Engineering units, Time Delay, Operator Control (Adjust Trip point and Disable), Alarm area, alarm priority.

.4 For discreet input alarms also list, time delay, Alarm area, alarm priority. For all alarms show and test alarm are conditioned as documented in Process Control Narratives.

.5 For Virtual Points also list, read/write access, minimum value, maximum value, default value and units of measurement.

.6 For trend points also list trending attributes.

.7 For Data messaged between PLCs show tagnames with descriptions.

.2 Testing procedure shall describe test operation of every individual device connected to the system as well as part of the overall system as a whole.

.3 Normal Device Operations:

.1 Local Mode Operations.

.2 Computer Manual Mode Operations.

.3 Transfer from Local to Computer.

.4 Transfer from Computer to Local.

.5 Computer Automatic Mode Operations.

.6 SCADA/Automation.

.4 Abnormal Device Operation:

.1 Uncommanded Operations.

.2 Unresponsive Commands.

.3 Device Operation Permissives.

.4 Device Alarms.

.5 Emergency Stop.

.6 Power failure.

.7 Process and equipment interlocks.

Part 2 Products

.1 Not Used.

Part 3 Execution

.1 Not Used.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Comply with the requirements of General Requirements and Specification Section 40 61 13 - Process Control General Provisions.

.2 Control panels (CP) house the control system at each of the basic levels of operator interface. Requirements apply to field panels, area control panels, PLC/RPU panels and all other panels used to house control and monitoring equipment.

.3 This Specification Section is a specification for custom-built panels. It does not cover any control panel supplied as part of packaged equipment such as a variable frequency drive.

.4 Use enclosures which conform to the requirements of the NEMA/EEMAC type specified or shown on Panel Drawings and requirements in this Specification Section.

.5 Ensure that the panels selected are large enough to contain all required equipment, with 25% of space for expansion.

.6 For new control panels to be provided refer to Drawings and any applicable Owner standards. Typical Drawings are based on typical layout and equipment for reference only. Final panel and hardware provided details shall be developed and selected to meet the desired operational intend of the system.

.7 If any supplied equipment lacks the required Canadian certification, supplier will be responsible for any costs incurred for special inspections and any resulting modifications required to meet Canadian codes.

1.2 SHOP DRAWINGS

.1 Comply with the requirements of Division 1.

.2 Provide internal and external Layout Drawings as part of Shop Drawings showing exact dimensions of the equipment provided:

.1 The internal and external Layout Drawings included in the Contract Drawings are based on typical equipment and are not to be used for fabrication.

.3 Provide calculations for sizing the cooling fans, air conditioners, heaters and heat exchangers.

.4 Provide colour chart for selection of the exterior colour where other than the standard colour is specified.

.5 Provide one additional set of panels "As-Built" Drawings and all PLC/PAC documents to place in the door pocket.

.6 Control Panel Shop Drawings:

.1 Control panel drawing submittals shall be submitted in accordance with Drawings and any applicable Owner standards.

.2 Contractor shall provide individual Shop Drawing packages for each control panel supplied.

.3 Each Shop Drawing package shall include as a minimum:

.1 Internal and external panel layout.

.2 PLC rack layout.

.3 All interconnection wiring diagrams.

.4 Terminal block layout.

.5 Complete loop diagrams for all I/O being wired to the control panel.

.6 Complete bill of materials.

.7 All manufacturer datasheets for every component and device supplied clearly detailing all options included.

.7 Bill of Materials showing item reference, tag, quantity, description, manufacturer, model number, and whether the item is shipped loose or installed.

.8 Scaled layouts of door and interior of panels.

.9 Provide Datasheets of all equipment provided. If equipment is member of a series identify the specific part number of the device/equipment used being provided in the datasheet.

.10 Separate Shop Drawings for the uninterruptible power supply, terminals, DC power supply, surge suppressor, push buttons, switches, indicator lights, relays, Ethernet switches, control panel breakers, disconnects, motor starters, overload relays, variable frequency drives, panel lighting, panel power bars etc.

.11 Separate Shop Drawings for the PLC including the rack, CPU, communication cards, I/O modules and cables.

.12 For panels with a touch-screen HMI panel, provide separate Shop Drawings for the HMI including installation details and cables.

.13 Separate Shop Drawings for step down transformer, if required.

.14 Loop Drawings or schematics showing all internal and field wiring along with terminal numbers, equipment tags, wire tags, settings (for example timer relays) and calibrated ranges (if applicable).

.15 Internal elevation of all back panels and equipment.

.16 External elevation including enclosure rating and dimensions.

.17 List of Lamacoid labels.

.18 Clearly identify field wiring connections and terminal numbers.

1.3 RECORD DRAWINGS

.1 Provide final as constructed Record Drawings for all control panels supplied or retrofitted. All retrofit works shall be clearly detailed.

.2 For all new control panels submit all control panel Record Drawings in editable CAD format in accordance with the Owner's CAD Standards.

.3 For all retrofitted control panels with existing CAD files, submit updated CAD files in the native format. If no CAD files were supplied, Contractor shall prepare new CAD files in accordance with Owner's CAD Standards.

Part 2 Products

2.1 GENERAL

.1 Assembled control panels and all internal components shall be CSA certified and a CSA or acceptable inspection lab tag shall be affixed to the front door of the enclosure.

2.2 CONSTRUCTION

.1 Panels must carry CSA/UL label.

.2 Provide 304 SS screws, bolts, fasteners and wall spacers.

.3 Place knockouts for the wiring of free-standing panels either at bottom or sides of the panel. Cover holes for future devices with plugs suitable for specified NEMA classification.

.4 Cut, punch, or drill cut-outs for face-of-panel mounted instruments and smoothly finish with rounded edges.

.5 Leave the space in the bottom 500 mm of the panel free of equipment for future use.

.6 Use panel fabrication techniques that allow for removal and maintenance of all equipment after installation.

.7 Install door mounted equipment flush mounted and properly sealed. Internal mounted panels to be at least 1.6 mm sheet steel, uniform size, with spare removable panels for future use.

.8 Fabricate panels, install instruments, plumb and wire in the factory. Arrange wiring and tubing terminations in the control panel to match floor (and or ceiling) openings. Test wiring and plumbing prior to shipment.

.9 For NEMA type 3R and type 4 panels, mount face-of-panel mounted devices such as indicating meters, controllers, etc. that are not weatherproof on a hinged inner door and provide a NEMA rated viewing window on the enclosure door.

.10 Locate face-of-panel mounted device higher than 0.8 m and lower than 2.0 m from the floor:

.1 Arrange status lights above corresponding pushbuttons or selector switches.

.2 Arrange digital and analog indicators above corresponding controls.

.11 Arrange back-of-panel devices in a neat and orderly fashion. Allow 20% continuous space for future additions. Use mounting plate for mounting all components.

.12 Environmental Protection:

.1 Provide internal condensation protection on all panels.

.2 Provide freezing protection with thermostat control on outdoor panels.

.3 Provide louvers, forced ventilation or air conditioners as required to prevent build-up and protect equipment, with ambient temperatures of up to 50° C. Provide louvers, forced ventilation, or air conditioners as required to limit temperature build-up to a maximum of 40° C to protect equipment.

.4 Provide HEPA air filter to reduce dust on electrical equipment.

.5 Provide clean instrument air purging arrangement with filter regulator and shut-off valve, as indicated in schedule or Panel Drawing.

2.3 ELECTRICAL

.1 Provide panels with switched full-length LED interior lights and mount near the top.

.2 Provide panels with a 15 A, 120 VAC service outlet circuit with surge suppresser within the panel. Provide the circuit with 3 wire, duplex receptacles, 1 for every 1.0 m of width (1 minimum per enclosure) and space evenly along the back-of-enclosure area. Provide ground fault interrupter type service outlet for outdoor panels.

.3 Provide signal conditioning as required.

.4 Wire in accordance with requirements of Specification Section 40 70 11 - Instrumentation Wiring:

.1 Use numbered terminal blocks for external connections.

.2 Provide instrument loop power supplies, mounting hardware, terminal blocks, control circuit breakers, and other items required for a fully operable panel.

.3 Furnish termination panels, if required. Include terminal blocks, interface hardware, wiring, and cabling necessary for a complete operational system.

2.4 NAMEPLATES AND LABELS

.1 Follow ISA-RP60.6-1984, Recommended Practice for Nameplates, Labels and Tags for Control Centres.

.2 Furnish face-of-panel mounted nameplates to identify systems and equipment:

.1 Use engraved gravoply laminate nameplates having black letters on white background.

.2 Include device identification number as well as a descriptive name.

.3 Center lettering on each line.

.4 Use minimum 6 mm high characters.

.5 Mount nameplates with 2 stainless steel self-threading screws.

.6 Name plate describing Panel Name and Panel tagname if requested to be installed inside the panel.

.3 In the panel interior, furnish surface mounted nameplates to identify each device mounted on the panel exterior and interior:

.1 Use engraved gravoply laminated nameplates with black letters on a white background.

.2 Place the tags above, but not on the device.

.3 Do not obstruct visibility by wire bundles or other equipment.

.4 Include device identification number as well as a descriptive name to match identification shown on Drawings.

.5 Mount nameplates with 2 stainless steel machine screws.

.4 Label all front and internal mounted devices with the following information:

.1 Manufacturer, model and serial number.

.2 Input and output ranges.

.3 Power supply limits.

.4 Pressure rating if applicable.

.5 Enclosure classification.

2.5 ALL ENCLOSURES

.1 NEMA rated enclosures:

.1 For electrical room or similar environment – NEMA 12 mild steel.

.2 For process areas – NEMA 4X stainless steel c/w NEMA 4X drain to prevent moisture accumulation.

.2 Twelve (12) gauge steel, seams to be continuously welded and ground smooth with body stiffeners (as required), back panel supports, heavy duty hinges, heavy duty lifting eyes (as required), oil resistant door gasket, grounding stud on doors and body and painted ASA 61 – Grey or unpainted if stainless steel.

.3 Enclosures shall be NEMA 12 classification, unless site conditions dictate otherwise, sized as required, and be equipped with a front access door. Enclosures shall be complete with all instruments, meters, control switches, indicating lights, programmable control I/O modules, power supplies, wiring terminals and other devices as required.

.4 Enclosures shall be fabricated of high grade cold rolled sheet steel, 12 gauge 3.5 mm.

.5 All doors and edges shall be neatly turned in and smooth finished. No visible welding seams will be accepted.

.6 Enclosures shall be rigidly braced and stiffened to prevent any "bowing" or deformation during shipping or installation.

.7 Unless otherwise indicated, doors on freestanding enclosures are to be flush fitting, gasketted, hung on concealed or piano type hinges and provided with a 3-point latch and locking type handle. Doors on wall-mounted enclosures shall be gasketted and provided with quarter-turn screwdriver latches.

.8 Enclosures shall be fitted with an interior, removable 2.7 mm thick steel equipment mounting back-plane.

.9 Cutouts for panel-mounted equipment are to be neatly cut, properly aligned and sized so that the hole is completely covered by the front bezel. Equipment and instrument cases shall preferably be held in place by rear connected fittings. Any front fixing required shall be only by means of chrome-plated machine screws.

.10 A metal document pocket shall be mounted within the enclosure, minimum 300 mm wide.

.11 Enclosures shall be completely dead front type with flush panel mounted equipment having back connection terminals. Instrument bezels and switch escutcheon plates shall be a match colour, suitably blending with the colours of the control panel.

.12 All panel-mounted equipment shall be complete with an engraved legend on black lamacoid nameplate having white letters no smaller than 6 mm. The panel shall have an engraved identification nameplate having letters no smaller than 12 mm.

.13 Panel enclosures shall be smooth, free of sharp edges and blemishes, and thoroughly degreased before finishing. All interior and exterior surfaces shall receive no less than 2 coats of an approved undercoat applied over an approved rust-inhibiting prime treatment. The factory applied finish shall comprise of no less than 2 coats of a satin-finish, high quality, air-dried enamel having proven durability and resistance to abrasion.

.14 All panels shall be equipped with internal LED lamps and switch, and 120 VAC convenience power duplex receptacles.

.15 Paint steel enclosures. Prime with one coat and finish with 2 coats of factory finished, epoxy-based paint. Paint the panel interior white. Paint the exterior colour ANSI/ASA61 – standard gray, if not otherwise specified.

.16 Maximum height of the panel (not including plinth) is less than 1,900 mm unless otherwise noted on Drawings.

.17 Manufacturers: Hammond.

2.6 FREE-STANDING ENCLOSURES — STAINLESS STEEL

.1 Fabricate enclosures from sheet steel:

.1 Provide single door enclosures with 2.67mm (12 gauge) sides top, and back.

.2 Provide double door enclosure with a 3.43mm (10 gauge) back with 2.67mm (12-gauge) top and sides.

.3 Provide multi-door enclosures with 3.43 mm (10 gauge) sides, top, and back.

.2 Grind and sand exterior welds to a smooth finish free of burrs, mill scale, rust, grease, and oil. Make surfaces free of ridges, nuts, bolt heads, and similar protrusions. Fill all imperfections and sand smooth.

.3 Internally, supply the enclosures with a structural steel framework or bracing for equipment support and enclosure bracing. Permit lifting without racking or distortion. Provide removable lifting rings designed to facilitate rigging and lifting of the enclosure during installation. Provide steel plugs to fill the lifting ring holes after installation is complete.

.4 Arrange rear access doors and size such that they extend no further than 600 mm beyond the enclosure when opened to the 90° position.

.5 Provide enclosures with louvers except for enclosures mounted with their backs directly adjacent to a wall, place louvers in the rear of the enclosure, top and bottom. For enclosures mounted with their backs directly adjacent to a wall, place louvers on the sides.

2.7 WALL MOUNTED ENCLOSURES – STAINLESS STEEL

.1 In addition to the NEMA standard, meet the following requirements:

.1 1.91 mm (14-gauge) minimum metal thickness.

.2 Doors shall be 2.67mm (12-gauge) minimum thickness, rubber-gasketed with continuous hinge.

2.8 ENCLOSURES – STAINLESS STEEL

.1 Adhere to requirements of steel panels. Exterior painting is not required. Finish exterior in brushed or matt.

2.9 ENCLOSURE ACCESSORIES (IF REQUIRED)

.1 Window Kits:

.1 Provide window kits suitable for NEMA/EEMAC type 4, 4X and type 12 enclosures to allow visual status verification of devices mounted behind the door.

.2 Provide windows with 6 mm clear acrylic with steel frames. Use stainless steel frames and polycarbonate window for NEMA type 4X enclosures.

.3 Provide an oil-resistant gasket to ensure a watertight seal around the window and window frame.

.4 Provide window kits in a variety of sizes ranging from 75 mm × 125 mm, to 600 mm × 910 mm.

.2 Louvers:

.1 Include washable aluminum air filters with louvers used for ventilation.

.3 Fans:

.1 Provide forced ventilation fans, where used, with washable, aluminum air filters and finger guards.

.2 Operate fan motors on 115 VAC, 60 Hz power. Include thermal protection. Use motors rated for 20,000 hrs of continuous operations without lubrication or service.

.3 Provide exhaust grilles with filters.

.4 Provide 1 can of filter spray adhesive for every enclosure.

.4 Closed Loop Air Conditioners:

.1 Provide closed loop cabinet air conditioners to protect panel equipment from ambient temperatures up to 50° C and solar radiation where specified in the schedule or Panel Drawing.

.2 Meet the following requirements:

- Power: 115 VAC, 60 Hz.
- Mounting: Vertical on side or back.
- Capacity: 1,200 to 10,000 BTU per hour as required by the cabinet equipment.

.3 Provide protective coatings on coils and copper lines to reduce corrosion damage.

.5 Heaters for Condensation Control:

.1 Provide thermostatically controlled, fan-driven heaters for all enclosures for condensation control unless otherwise specified.

.2 Meet the following requirements:

- Power: 115 VAC, 60 Hz.
- Rating: 100 Watts for panels smaller than 61 cm by 122 cm.
  200 Watts for larger panels.

.3 Provide thermostats that sense air temperature in the panel and are adjustable from 4 to 25° C.

.4 Mount heaters near the bottom center of the enclosure. Do not mount electronic components closer than 15 cm to the heater.

.6 Heaters for Freeze Protection:

.1 Provide thermostatically controlled heaters for freeze protection down to –30° C for all outdoor panels or as specified in the schedule or Panel Drawing. Size heaters to maintain the inside temperature above 4° C.

.2 Meet the following requirements:

- Power: 115 Vac, 60 Hz.
- Minimum Rating: 100 Watts for panels smaller than 25 cm by 41 cm.
  150 Watts for panels smaller than 31 cm by 62 cm.
  250 Watts for panels smaller than 46 cm by 76 cm.
  500 Watts for panels smaller than 61 cm by 122 cm.

.7 Moisture and Corrosion Protection:

.1 Self-regenerating desiccant in heat-sealed, semi-permeable packet, Humidisorb by A+ Corporation. Provide the size and number of packets needed to protect the size of panel.

.2 Self-regenerating desiccant with vapour corrosion inhibitor in heat-sealed, semi-permeable packet, Humidisorb Plus X-Corrode by A+ Corporation. Provide the size and number of packets needed to protect the size of panel.

2.10 SELECTOR SWITCHES

.1 Provide selector switches where identified on the Contract Drawings:

1.	Type:	Heavy duty Oil-tight 2, 3 or 4 position, maintained contact selector switches.
2.	Two-way selector switches:	"make before break" for both switch positions.
3.	Number and arrangement of contacts and their function:	In accordance with schematic control diagrams and the specified functional requirements; minimum 1 SPDT
4.	Contact blocks:	Heavy duty silver to silver butting type contacts, and on low voltage (24 VDC or less) circuits: gold plated contacts rated 0.5 A at 115 VAC.
5.	Contacts:	Rated for 10A, 120 VAC.
6.	Size:	Approximately 30.5 mm
7.	Electrical rating:	Equal class, division and group rating of the area.

.2 Manufacturers: ABB:

.1 A-B 800T series (Type 4/13 oiltight/watertight), or

.2 A-B 800H series (Type 4/4X/13 corrosion-resistant/oiltight/watertight) in process areas.

2.11 PUSHBUTTONS

.1 Provide push buttons where identified on the Contract Drawings:

1.	Type:	Heavy Duty NEMA Oil-Tight, flush-head push buttons with momentary operation.
2.	Contact blocks:	Heavy duty silver to silver butting type contacts, and on low voltage (24 VDC or less) circuits: gold plated contacts rated 0.5 A at 115 VAC.
3.	Contacts:	Rated for 10A, 120 VAC.
4.	Number and arrangement of contacts and their function:	In accordance with the schematic control diagrams and specified functional requirements; minimum 1 SPDT.
5.	Size:	Approximately 22.5mm
6.	Electrical rating:	Equal class, division and group rating of the area.

.2 Manufacturers: ABB.

2.12 INDICATING LIGHTS

.1 Provide status lights where identified on the Contract Drawings:

1. Type: NEMA Oil-Tight, heavy duty LED status lights which allow bulb removal and replacement through the front of the unit.
2. Test Function: Provide a push button with suitable diodes to test all indicating LED light units.
3. Size: 30.5 mm full face
4. Electrical rating: Equal class, division and group rating of the area.

.2 Field status and alarm lights shall confirm to the following colour convention:

ITEM	COLOUR
Running, burner on, valve open, breaker closed:	Green
Stopped, safe, burner off, valve closed, breaker open:	Red
Overload, warning:	Amber
Alarm:	Flashing Red

.3 Manufacturers: Allen Bradley (800 T series).

2.13 CONTROL RELAYS

.1 Control relays shall be of the plug-in, encapsulated type. Relay pole configurations shall be 3PDT. Relays shall be equipped with internal neon pilot indicators. Coil voltage shall typically be 120 VAC 60 Hz and contacts shall be rated for 5 Amps.

.2 Relay bases shall be of molded unbreakable nylon/plastic construction, configured for screw or DIN rail mounting. Terminal screws shall permit connection of up to 2 #12 AWG conductors per terminal.

.3 Manufacturer: Phoenix Contact.

2.14 TIMER RELAYS

.1 Timer relays shall be solid-state digital display, multiple range, programmable operation, and plug-in encapsulated assembly.

.2 Timer operating configuration shall be as required. Output contacts shall be DPDT rated 3A, 120 VAC. Supply voltage shall typically be 120 VAC.

.3 Relay bases shall be of molded unbreakable construction, configured for screw or DIN rail mounting. Terminal screws and pressure pads shall permit connection of up to two #12 AWG conductors per terminal.

.4 Manufacturer: Phoenix Contact, Allen Bradley.

2.15 POWER FAILURE RELAY

.1 Provide a power failure relay installed in each PLC Panel. The relay shall be connected to the main power supply to the panel (typically a 120 VAC branch circuit), and shall

indicate loss of supply power to the panel, while the panel components operate on the standby UPS.

.2 Manufacturer: Phoenix Contact, Allen Bradley.

2.16 ELECTRONIC DIGITAL INDICATORS

.1 Electronic digital indicators shall be provided for panel installation as required, for display of identified process variables or quantities.

.2 Indicators shall be powered by 120 VAC, and input signal shall be 4-20 mA.

.3 Indicators shall be 31/2 digit LED type, minimum height 25 mm numbers, with adjustable decimal point.

2.17 CURRENT LOOP ISOLATORS (I/I)

.1	Input signal:	4-20 mA.
.2	Output Signal:	4-20 mA.
.3	Input Impedance:	250 ohms maximum.
.4	Output Load Capability:	900 ohm.
.5	Power Supply:	24 VDC.
.6	Accuracy/Linearity:	0.1%/0.1% of span
.7	Mounting:	DIN Rail.

2.18 LOOP POWER SUPPLIES

.1 Loop power supplies shall be provided within control panels for supply to 2-wire transmitter analog circuit loops as indicated on the Drawing. The quantity of power supplies and separate isolated supply potentials shall be as required for the circuits indicated.

.2 Output voltage shall be nominally 24 VDC with a minimum circuit current capability of 2 ADC. Output shall be regulated and crowbar protected. Voltage accuracy, regulation noise and ripple shall be within limits to ensure that the powered instruments can be operated to their specified tolerances. Barriered output terminals shall be provided with circuit number and polarity clearly identified.

.3 Input voltage shall be 120 V, 1- ph, 60 Hz AC.

.4 Control Panel Power Distribution.

.5 Circuit breaker terminal blocks for sub-circuit power supplies shall be rated as required by the hardware or field devices for manufacturer's recommended protection.

.6 Control Panels shall be provided with a 120 VAC supply from circuit distribution panel.

.7 Manufacturer: Phoenix Contact.

2.19 TERMINAL BLOCKS

.1 Terminal blocks shall be provided c/w mounting rails or channels for connection to field device wiring. Terminals shall be tubular clamp type, 6 mm, rated at 600 volts with the current rating being equal to the maximum current rating of the conductors but not less than 10A.

.2 Terminals shall be easily accessible for attachment of field connections. Each terminal shall be clearly marked with factory pre-marked number and/or letter tag identifiers. Each field-connecting conductor shall be served by one terminal. Provide a minimum of 25% spare unit terminals in each panel.

.3 Spare terminals shall be interspersed among active terminals, generally, 2 terminals for each group of 8 terminals. Spare terminals shall be identified with removable double 'S' factory pre-marked tags.

.4 In addition to spare terminals identified above, each unused programmable controller I/O module point (discrete or analog) shall be wired to terminal blocks and identified with the I/O address and the letter 'S' denoting spare.

.5 All spare conductors shall be terminated on terminals.

.6 For grounds require bonded grounds and for all jumpered wires use jumper bars.

.7 Manufacturer: ABB/Entrelec - (SNK Series).

2.20 CIRCUIT BREAKERS

.1 Circuit breakers shall be provided c/w mounting rails. Circuit breakers shall be easily accessible for attachment of field connection. Din rain mounted.

.2 One Hundred Twenty (120) VAC 60Hz. 1 Pole Circuit Breakers.

.3 Manufacturer: ABB/Entrelec (SU201M- series).

2.21 FUSED TERMINAL BLOCKS

.1 One Hundred Twenty (120) AC fuse terminal block with indicator c/w fast acting fuse.

.2 Twenty Four (24) DC fuse terminal block with indicator c/w fast acting fuse.

.3 Provide terminal blocks with end plate. Din rail mounted.

.4 Manufacturer: ABB/Entrelec (SNK - series).

2.22 INTERNAL COMPONENT IDENTIFICATION

.1 Each internal panel device or instrument shall be fitted with a permanent nameplate on, or above the device, with the device identification imprinted.

2.23 PANEL FACEPLATE DEVICE IDENTIFICATION

.1 Panel face devices shall be provided with lamacoid nameplates, black with white lettering.

.2 Final nameplate wording, colouring and sizes shall be approved by the Engineer

2.24 SURGE AND LIGHTNING PROTECTION

.1 Supply and install in the PLC panel lightning and surge protection equipment to suit incoming Bell Canada lines.

.2 TVSS metal oxide varisters technology.

.3 For RF grounding and bonding refer to the Polyphaser manual.

.4 Manufacturer: Phoenix Contact.

2.25 WIREWAYS

.1 Plastic wiring raceway with removable covers, sized for 50% fill (including field wiring):

.1 Gray colour for all raceways.

.2 Ensure that sufficient wiring raceway is provided to ensure space for field wiring needs, including separate raceways for 24 VDC and 120 VAC conductors.

.3 Manufacturer: Panduit.

2.26 GROUNDING

.1 Provided grounding lug, suitable for termination of #6 to #2 AWG copper grounding cable.

.2 Separate grounding bars are to be provided for power grounds and instrument control system grounds (signal cable grounding, etc.). The instrument ground bar is to be isolated from the panel and connected to the power ground with a #14 AWG wire.

2.27 CONTROL PANEL WIRING

.1 All new works on new and existing control panels shall meet the following cable and wire label schemes.

.2 PLC Control wiring shall comply with the following color code:

Wire Purpose	**Wire Color Code**
Line & Load Circuits AC/DC Power:	Black
AC Control Circuits:	Red
DC Control Circuits:	Blue
Foreign Source Interlock Control Circuits:	Yellow
DC Signals Grounding Conductor:	Green/White Strips
Equipment Grounding Conductor:	Green

DC Power:	Blue
Analog Signal:	White (+), Black (-)
Intrinsically Safe Circuits:	Blue

.3 PLC/Remote I/O panel associated Field wire labels shall follow the following scheme:

.1 Power:

.1 "CB#".

.2 "N".

.2 Digital Inputs:

.1 "Field Device tag" / "PLC Panel" / "F PLC Panel Terminal Block".

.2 "Field Device tag" / "PLC Panel" / "PLC Panel Terminal Block".

.3 Digital Outputs:

.1 "Field Device tag" / "PLC Panel" / "PLC Panel Terminal Block" or "Control Relay termination point".

.2 "Field Device tag" / "PLC Panel" / "PLC Panel Terminal Block" or "Control Relay termination point".

.4 Analog Inputs:

.1 "Field Device tag" / "PLC Panel" / "PLC Panel Terminal Block" +.

.2 "Field Device tag" / "PLC Panel" / "PLC Panel Terminal Block" -.

.5 Analog Outputs:

.1 "Field Device tag" / "PLC Panel" / "PLC Panel Terminal Block" +.

.2 "Field Device tag" / "PLC Panel" / "PLC Panel Terminal Block" -.

.4 Identify control and instrument wires with permanent, indelible numbered markings on both ends of wires, i.e. at all points of terminations and splices. Characters to be no less than 2 mm high. Numbering shall not be handwritten.

.5 All control wiring to be provided with wire markers at both ends of the conductor. Wire markers to be heat shrink type with machine printed numbers.

.6 Refer to - Kenora Standard Typical Documentation for the Typical PLC Control Panel Drawing which includes control wiring labeling scheme and wire colors. Wiring Identification and Labelling:

.1 Wiring identification and labelling is to be implemented in order to clearly identify each conductor installed within the system with the goal to facilitate troubleshooting and maintenance. All conductors, including spares, are to be identified at each end and at any connection, termination, junction box, pull box or intermediate manhole with the appropriate labels. Labels shall be identified by machine printed labels. Hand printed labels are not acceptable. Labels shall be oriented for easy readability. Each conductor originating at the PLC shall be defined with a unique alphanumeric label as defined in the standards.

.2 Wiring markers and labels shall be of the following characteristics, or otherwise approved by the Engineer.

.1 Manufacturer and P/N: Thomas & Betts, E-Z-Code.

.2 Description: Printable self-laminating, self-adhesive markers.

.3 Colour: White background with black lettering.

.4 Material: Vinyl plastic or polyester film suitable to environment.

.7 Each wire marker shall be sleeved with clear heatshrink tubing ensuring maximum protection of the label against oils, grease, water, chemicals and other foreign matter.

Part 3 Execution

3.1 INSTALLATION

.1 Construct a 100 mm high concrete curb, with dimensions as specified or noted in the schedule or Panel Drawing on which to install floor mounted control panels.

.2 Where 2 or more enclosures are shown mounted immediately adjacent to one another, install both of them securely together with their front faces parallel.

.3 After setting panel in place, remove the lifting rings and fill the lifting ring holes.

.4 For each panel provide a complete wiring diagram. Place the diagram in the document pocket.

.5 Install a maximum of 1 wire per terminal.

.6 All control panel wiring shall be terminated on approved terminals.

.7 Control panel wiring junctions shall be made using terminal blocks. Wire splices are not allowed.

.8 Provide end brackets and lamacoid markers to identify groups of terminals.

.9 Each terminal shall be uniquely identified and labelled.

.10 The control panel shall isolate wiring with different voltages (i.e.) 600 VAC circuitry shall be separated from120 VAC circuitry; and 120 VAC circuitry shall be isolated from 24 VDC circuitry, by means of separate wireways.

.11 Each wire shall be tagged at both ends. The tag shall identify the component where the ‘opposite’ end of the wire is connected to, such as terminal strip and junction box, terminal strip and control panel, relay name/number including the relay’s contact number, relay name/number including the relay’s power coil terminal number, etc.

.12 All spare wires terminated within the Control Panels shall be labelled as follows: SPARE-1, SPARE-2, SPARE-3, etc.

3.2 COMPONENT INSTALLATION

.1 The contractor is responsible for the general arrangement of components to be installed. Equipment shall be mounted to ensure adequate clearance between door mounted and back-plane mounted components with the panel door closed. All items shall be clearly identified with an engraved lamacoid nameplate securely fastened in place.

.2 All internally mounted equipment shall be arranged for ease of access and removal when necessary. Flexible wiring harnesses with approved terminating connectors at both sides shall be provided for any hinged panel or door-mounted equipment and each shall have 20% spare capacity.

.3 The panel shall be provided with a tapped copper bus bar for panel components and shield grounding, plus 20% spare.

.4 Relay base and terminal block rails shall be located square to the back plane. Door mounted instruments shall align horizontally and vertically on edges or centerlines.

.5 Fastening of equipment assemblies to the panel back planes shall be by means of appropriately sized drilled and tapped screw holes. Machine screws only with lock washers are to be used; self-tapping hardware is not acceptable.

.6 Provide corrosion protection for each panel.

3.3 WIRING METHODS

.1 All wiring shall be neatly formed and frequently supported. Wire ducts 3” deep shall be installed beside all terminal strips and PLC I/O. A primary requirement will be neatness. No splices will be allowed. All wiring shall be installed continuous from terminal to terminal.

.2 Each wire termination at a stud shall have a raise fork type crimp-on connector. All wiring terminating at tubular screw terminals shall be stripped for full insertion into the terminal. Wiring termination at solder terminals shall be mechanically secure before solder is applied. Resin type solder shall be used.

.3 Wire looms shall be secure and wire forming shall provide enough length to ensure that there will be no mechanical tension on wire terminations.

.4 Wires installed at terminal blocks shall be at right angles to the terminal and have adequate spare length to reach up to 4 terminal blocks either side of the termination point.

.5 Mechanical checks shall be made to determine if there are any broken parts, wires, mechanical binding, loose screws, and proper soldered connections. Mechanical tolerances shall be checked on all units including contact grip and wires.

.6 Each panel shall be bonded to the building ground system.

3.4 INSPECTION AND TESTING

.1 Factory assembly and tests of control panels in accordance with Division 26 and 40.

.2 Field performance and operational tests in accordance with Division 26 and 40

.3 Turn over to the owner all installation software, user manuals, accessory cables, calibration units, or any other material accompanying the installed equipment.

.4 Panel Field Acceptance Testing (FAT) shall be completed, signed off and tested to the Owner, Engineer and supply contractor satisfaction before shipping of the panel to site. All deficiencies shall be corrected before shipping to site.

3.5 PACKAGING AND SHIPPING

.1 The panels shall be prepared for shipment so as to protect it from physical damage. Assemblies shall be packaged in generously padded cartons or containers. Partial shipment shall only be allowed by written approval of the Owner's Representative.

.2 All shelf mounted instrumentation shall be removed from the panel before shipment, and re-packaged in its original containers for shipment to the job site.

.3 Any other "loose" components shall be taped or tied down, and/or supported with polyurethane foam so as to provide a tight, vibration free shipping unit.

.4 In addition to the Owner's name and the shipping destination, the outside of each crate or carton shall be marked with the Purchase Order and Item Number(s). A label listing contents and a duplicate listing shall be included inside the package.

3.6 PAINTING

.1 Painted surfaces on material supplied or installed under this contract which are damaged in any way, i.e. by welding, scraping, cutting, etc., to be thoroughly cleaned, primed with a rust inhibiting primer and repainted to the original colour. The finished product shall meet or exceed the original painting specification.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This Specification Section specifies the supply, installation, field-testing, and placing into operation of instrumentation.

.2 Coordinate with other Divisions for instrumentation supplied.

1.2 REFERENCES

.1 ANSI/ISA-S5.1-1984 (R. 1992) Instrumentation Symbols and Identification.

.2 ANSI/ISA-S5.4-1976 (Revised 1989) Instrument Loop Diagrams.

.3 ISA-S20-1981 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

1.3 DESIGN REQUIREMENTS

.1 The Drawings have been developed on a conceptual basis. Provide devices, components and accessory items necessary for the operation of the control system.

.2 Provide all conduit and cabling necessary for installation of instruments including all new and existing instruments to be integrated into the SCADA system as per the Contract Drawings. Use only new instruments where instruments are to be supplied under this contract.

1.4 SUBMITTALS

.1 Submit Shop Drawings in conformance with Specification Document 01 33 00 – Submittal Procedures.

.2 Not later than 4 weeks before commencement of work, submit the following:

- .1 Instrument data sheets, conforming to ISA-S20.
- .2 Descriptive literature.
- .3 Manufacturer’s installation diagrams for field-mounted equipment.
- .4 Piping drawings for field-mounted equipment.

.3 Not later than six weeks before commencement of work, submit the following:

- .1 Loop wiring diagrams and control schematics conforming to ISA-S5.4 showing the connections at each device and wiring or cabling between devices. The diagrams are to be fully comprehensive so that every circuit loop can be followed completely. Indicate types of loads, switches, transducers and power supplies such as motors, relays, lights, indicators, float switches, hand switches, isolators, signal selectors, dedicated 24 VDC power supplies, etc. Number and identify each component circuit and terminal. Contain a loop on a maximum of 2 sheets, preferably 1 sheet. (This is required for modifications to existing facilities and new equipment).
- .2 Instrument panel Layout Drawings.
- .3 Instrument panel wiring diagrams.

.4 Not later than 2 weeks prior to Site Acceptance Testing, submit the following:

.1 Completed Input/output test reports.

.2 Installation, calibration and operational certifications by the manufacturer.

.5 Prior to the completion of the work, submit the following:

.1 Final, as-constructed instrument loop diagrams.

.2 Final, as-constructed data sheets.

.3 Maintenance manuals.

.6 A list of recommended spare parts including the make, model number, suggested quantity, cost, and required lead time of each part:

.1 Instrument calibration forms.

.2 Control Loop checkout/verification forms.

.3 Programmable Instrument and Equipment Configuration Summaries.

.4 Submit the following for each model instrument provided:

.1 Manufacturer's design and performance specification data and descriptive literature.

.2 Equipment dimensioning and installation requirements and recommendations.

.3 Required and optional accessories lists.

.4 Electrical/pneumatic signal and power connection diagrams.

.5 Operation and maintenance documentation for each type of instrument after product approval.

.6 Calibration certifications from the manufacturer for each calibrated instrument.

.7 List of recommended spare parts and spare parts to be provided.

.8 List of optional accessories.

.5 Submit the following for each instrument provided:

.1 Tag number and description.

.2 Complete model number.

.3 Instrument Data Sheets (ISA Standard -S20) with all fields completed.

.4 Catalog literature edited to indicate specific items provided with all options clearly highlighted. All deviations from Specifications shall be clearly noted and submitted to the Engineer for approval.

.5 Mounting details for all typical installation requirements and special details for non-typical applications.

.6 Methods and materials required for installation. Include power and signal connection details.

.6 Other specific submittal information as specified in the particular instrument specification.

1.5 QUALITY ASSURANCE

.1 Provide instrumentation of rugged construction designed for the site conditions. Provide only new, standard, first-grade materials throughout, conforming to standards established by Underwriter's Laboratories (UL), Inc., and so marked or labeled, together with manufacturer's brand or trademark.

.2 Provide material and equipment in accordance with applicable codes and standards, except as modified by the Specifications.

.3 Use single source manufacturer for each instrument type. Use the same manufacturer for different instrument types whenever possible.

.4 Coordinate instrumentation to assure proper interface and system integration. Provide signal processing equipment, to include, but not be limited to, process sensing and measurement, transducers, signal converters, conditioners, transmitters, receivers and power supplies.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Provide and securely attach the tag number and instructions for proper field handling and installation to each instrument prior to packaging.

.2 Package instrumentation to provide protection against shipping damage, dust, moisture and atmospheric contaminants.

.3 Include a shipping label which contains the following information:

.1 Tag number and description.

.2 Instructions for unloading, transporting, storing and handling at the site.

.4 Unload, transport, store and handle instrumentation at the site. Inspect instrumentation for damage in shipment and return damaged instrumentation to the manufacturer.

.5 Do not store instrumentation out-of-doors. Provide dry, clean storage facilities.

Part 2 Products

2.1 GENERAL

.1 Supply, install, calibrate, configure and commission all instrumentation as required by this Division.

.2 Refer to each individual Section within Division 40 for all acceptable manufacturers.

.3 Supply and install a stainless-steel tag for each instrument.

2.2 MANUFACTURERS

.1 Provide the following availability and local support for proposed manufacturers if different from the manufacturers cited in the individual instrument specifications:

.1 Replacement electronics, sensors and transmitters must be stocked locally, within 2 hrs delivery.

.2 Other hardware is to be available in no longer than 5 days.

.3 On-site technical support within 24 hrs is to be available.

Part 3 Execution

3.1 INSTALLATION

.1 Install instruments as shown on the furnished instrument installation.

.1 Obtain and use instrument mounting details from the manufacturer or supplier for installation purposes.

.2 Where the instrument installation details furnished with the Specification conflict with the manufacturer's installation detail, mount the instrument in accordance with manufacturer's specifications and instructions.

.3 Install units where indicated on the Contract Drawings.

.2 Unless shown otherwise, do not mount direct reading or electrical transmitters on process piping. Mount on instrument racks or stands or in enclosures near the sensor at a level that permits viewing from floor elevation.

.3 Install the instrumentation and auxiliary devices such that they are accessible for operation and maintenance.

.1 Generally, install instrumentation to be accessible from floor level or grade.

.2 Locate indicators such that indicator display is readily readable at eye level (1,500 mm –1,600 mm) from floor elevation.

.3 Locate transmitter with adequate clearance and accessibility for service. For pipe/rack mounted instruments at least 1,000 mm distance/ clearance to the wall.

.4 Allow sufficient clearance for cover removal and adjustment of switches.

.5 Provide adequate clearance (50 mm minimum) from piping and other obstructions for operation of valve handles.

.6 Provide safe access to the sensor.

.4 Route signals in flexible, conduit for up to a meter (as appropriate to allow removal of the sensor) and thereafter in rigid PVC conduit.

.5 Support sensor heads and electronic enclosures with a separate support bracket where the:

.1 Process pipe or tank is not adequate to support the additional weight.

.2 Process pipe or tank vibrates excessively (beyond manufacturer's recommendation).

.3 Instrument head extends more than 200 mm from the pipe or tank wall.

.4 Where vibration of the process piping is excessive (beyond manufacturer's recommendation), connect instruments using flexible tubing.

.6 Install EYS seals as required to comply with OESC when mounting any instrument or switch in classified areas.

.7 Attach a tag with engraved letters to each primary element, transmitter, and readout. Include the following information:

.1 Tag number.

.2 Description.

.3 Include manufacturer name and model number if not discernible on the instrument.

.8 Install all instruments in strict accordance with the manufacturer's requirements and recommendations.

.9 Use stainless steel or aluminum hardware for all installations, except where manufacturer's recommendations state otherwise or otherwise specified in the Contract Documents or Contract Drawings. Ensure dissimilar metals are not combined. Ensure all

supports are retractable to provide convenient access for maintenance and servicing of instrumentation.

.10 Contractor to wire all alarm points in a 'failsafe' configuration, such that the loss of power, opening of the contact or break in the control circuit wiring will activate an alarm.

3.2 ELECTRICAL SUPPLY

.1 Power supply to 120 VAC instruments is to be from the RPU/PLC Control Panel specific to the loop requirement.

.2 Provide individual breakers for power distribution to 120 VAC instruments or power supplies.

.3 Provide a separate (independent) circuit on a power distribution panel board to power each analyzer.

.4 Provide a local power on/off switch disconnect for each 120 VAC powered instrument.

3.3 FIELD QUALITY CONTROL

.1 Provide instrument manufacturer's services for installation assistance, field calibration, startup and training as specified in the individual instrument Sections.

.2 Remove shipping stickers, paint splatters, dirt, grease and other contaminants to restore the instrumentation to a clean and like new condition prior to final acceptance.

3.4 CALIBRATION

.1 After the instrument is fully installed, (including mounting, process connections, signal connections and power connections) and after the process is put into test mode or actual operation, perform preventative maintenance tasks and calibrate the instrument.

.2 Calibrate measurements over the range of the instrument including zero, full range and three intermediate points. Repeat 2 times for increasing and decreasing test points. For differential pressure (Level and Flow), repeat test 2 times at 0-100% calibrated range for increasing and decreasing test points.

.3 Demonstrate alarms by varying process conditions. Repeat 3 times.

.4 Prepare instrumentation installation and calibration certification sheet for each primary element sensor and electronic indicator/analyzer/transmitter for each instrument uniquely specified.

.5 For each certification sheet, include the following information:

- .1 Project name.
- .2 Tag number and description.
- .3 Manufacturer.
- .4 Model and serial number.
- .5 Date, time and person who performed calibration.
- .6 Calibration data to include:
  - .1 Input, output, and error at 0, 25, 50, 75, and 100 % of span for analog instruments.
  - .2 Switch setting, contact action, and deadband, if applicable, for discrete elements.

.7 Space for comments.

.8 Certification by installer and acknowledgment by contractor and date.

.6 In the Instrument Data Sheet(s), document the results of calibration and note any settings or adjustments made.

3.5 TESTING

.1 Refer to Specification Section 40 80 00 – Commissioning of Process Systems.

3.6 TRAINING

.1 Provide comprehensive training session by manufacturer's representative for each instrument type to operating and maintenance personnel.

.2 Provide separate single training sessions for operations and maintenance.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Field Wiring is the wiring that connects the field equipment (instruments, control stations, control panels, MCC) to the Main Process Control Unit. Use only CSA approved and labelled cables and conductors.

.2 All wiring from field transmitters to Control Panels, including terminal blocks, shall be labelled using the Owner's Standard.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.2 Additional Section References:

.1 Division 26.

.2 Division 40.

1.3 SUBMITTALS

.1 Submit product data in accordance with Documents 01 33 00 - Submittal Procedures.

.2 Data to indicate system components, mounting method, source of power and special attachments.

1.4 DEFINITIONS

.1 Wire: A composition of several stranded copper wires, woven together and sheathed within a protective jacket to produce a standard AWG size.

.2 Cable: A grouping of 2 or more wires contained within a jacketed covering with an optionally integrated shield wire weave.

Part 2 Products

2.1 ANALOG SIGNALS

.1 Definition: Analog signals are 4-20 mA inputs received from field instruments.

.2 Single Pair Cable: For individual instrument circuits use single-pair, 2 inch lay, twisted, foil 100% shielded with bare #18 AWG copper drain wire, #16 AWG, 19 × 29 strand copper conductors CSA labelled tray cable at 600 V.

.3 Multi-Pair cables: For multiple instrument circuits, use multi-pair cables made up of individual single pair, 2 inch lay, twisted, foil 100% shielded with suitable drain wire, #16 AWG, 19 × 29 strand copper conductors CSA labelled tray cable at 600 V.

.4 Shields: Signal shields should have 1 ground point located at the power source unless otherwise recommended by the instrument/equipment manufacturer. Shields should be continuous through cabinets, panels, and junction boxes.

.5 The power supply connection for each individual field device circuit shall be wired through a fuse to ensure that a wiring fault of one field device does not adversely affect the operation of other devices sharing the same power supply.

2.2 DC DIGITAL SIGNALS

.1 DC digital signals are at 24 V DC originating from contact inputs

.2 Single Pair Cable: For individual contact closure circuits use single pair, 2 inch lay, twisted #16 AWG, 19 × 29 strand copper conductors CSA labelled tray cable at 600 V with RW90 insulation with PVC jacket.

.3 Multi-pair Cable: For multiple contact closure circuits use multi-pair cables made up of individual single pair 2 inch lay, twisted, #16 AWG, 19 × 29 strand copper conductors CSA labelled tray cable at 600 V with RW90 insulation with PVC jacket.

2.3 AC DIGITAL SIGNALS

.1 AC digital signals are 120 V AC and less than 20 A, and received from contact outputs used for controlling 120 V devices such as motor starters, push-buttons, pilot lights, and the like.

.2 Single Conductor: For single circuit use single conductor #14 AWG, 19 strand copper conductor at 600 V with RW90 insulation with PVC jacket.

.3 Multi-Conductor: For multiple circuits use multiple conductor #14 AWG, 19 strand copper conductor at 600 V with RW90 insulation with PVC jacket.

.4 The conductor designation is that green conductors are always at ground

2.4 ETHERNET PATCH CABLES

.1 Ethernet copper cables shall conform to IEC 1158-2. Shielded, twisted-pair.

.2 Also check with the manufacturer’s recommendation for special application.

2.5 FIBRE OPTIC CABLES

.1 Provide all fibre optic cables, connectors, and appurtenances that make up the backbone cable segments in accordance with the Contract Drawings.

.2 The fibre optic backbone cable segments shall meet the requirements of the TIA/EIA-568-B specification for 50-micron, multi-mode fibre.

.3 Fibre optic backbone cable shall meet or exceed the following minimum requirements:

.1 Six (6) fibre strands per cable.

.2 Indoor/Outdoor rating.

.3 Protect against ingress of water into the cable.

.4 FT4 Rating.

.5 Multimode (OM4).

.4 All fibre optic cables shall terminate at fibre optic patch panels in each panel.

Part 3 Execution

3.1 GENERAL

.1 Avoid running cables inside or under power cable trays. Where field wiring is in power cable trays, insulation must be equal to or greater than the highest voltage in the cable tray.

.2 Where power or signal cables must cross, make them cross at an angle of 90°.

.3 Communication cables will not be mixed with power or signal cables. Provide a separate conduit for communication.

3.2 SIGNAL SEPARATION

.1 Analog and 24 V DC Discrete Signals: Analog 4-20 mA signals and 24 V DC discrete signals should normally be in separate conduits. An exception to this standard may be made in cases where it would cause parallel conduit runs to the same device and combining signals would eliminate one conduit. In cases where the exception is used, both the analog and discrete signals should be twisted shielded pairs as described for analog signals previously. This exception will be limited to 3 m only.

.2 AC Digital and Control: AC digital signals and AC control wiring may occupy the same conduit, but all instrument power circuits should be isolated by a separate conduit from all AC digital and control circuits.

.3 Provide 20% spare wiring in each wiring conduit.

3.3 MISCELLANEOUS

.1 Thermocouple Extension Wire: Thermocouple extension circuits should be solid conductors and same gauge as the T/C of the same material as the associated thermocouple. Thermocouple signal lines should be continuous from the thermocouple connection head to the final termination point.

.2 Spare Conductors: Spare conductors in each conduit should be equal to 15% of the number required for both present and (defined) future conditions, but in no case less than 2 spare wires or 1 pair, should be installed. Each cable should have 10% spare conductors but not less than 2 conductors. Spare conductors should be terminated on a marked terminal strip or connector pin at each end.

.3 Termination: Wire at both ends of the cable should be terminated with pre-insulated solderless spade or ring lugs for maximum physical strength and electrical conduction. Wires should not be terminated on adjacent terminal points if accidental short-circuiting could cause tripping or closing of a breaker.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Testing is implemented to minimize commissioning time, to ensure that all supplied control panels and PLC, HMI and SCADA programming complies with all Owner's standards and meets the operational requirements before arriving to site.

.2 The system integrator is responsible for coordinating the implementation and testing of the system.

Part 2 Products

Not Used.

Part 3 Execution

3.1 CONTROL PANEL FACTORY ACCEPTANCE TESTING (PANEL FAT)

.1 All control panels supplied shall undergo a Panel Factory Acceptance Test and must pass the Panel FAT in the panel shop prior to delivery to site.

.2 The Panel FAT shall be witnessed and signed off by the Engineer and an Owner representative.

.3 Panel FAT shall verify that all control panels are constructed in accordance with the Contract Documents and all review comments supplied during the Shop Drawing reviews.

.4 All deficiencies noted at the Panel FAT shall be corrected prior to delivery of each control panel to site.

.5 Refer to Drawings and any applicable Owner standards for template to be followed for Panel testing checks and procedures.

3.2 INSTRUMENTATION TESTING

.1 All field testing, calibration procedures, commissioning procedures, etc. shall be approved by the Engineers:

.1 Instrument Calibration:

.1 A calibration schedule for each instrument shall be provided.

.2 Provide complete configuration and calibration certificates for each instrument.

.3 Supply all materials, equipment and labour necessary for calibration and commissioning.

.2 Instrument Installation:

.1 Verify that instrument installation details are consistent with the Contract Documents and manufacturer's installation recommendations.

.3 Instrument Testing:

.1 Each and every Instrument calibration, Final Loop Check and equipment operation checks will be witnessed by the Engineers. Upon satisfactory demonstration of instrument and/or loop operation, the Engineer will sign off that the loop check is complete.

.2 Devices are also to be tested for their repeatability, accuracy and operation by varying the process and simultaneously measuring and recording the information displayed by:

.1 An independent measuring instrument.

.2 The local transmitter indicator.

.3 All remote digital/mechanical indicators.

.4 The 4-20 mA (or digital value) measured at terminal blocks in the PLC panels and operator panels.

.3 Compare test results against the instrument calibration reports and planned SCADA analog input range. As an example, flow sensors will require testing using a “draw and fill” test of a local container.

.4 Where no field calibration has been done, perform a calibration test. Go up, down and then back up the instrument range, testing at 5 points each time: 0%, 25%, 50%, 75% and 100%.

.5 The instrument switches, such as pressure switches or building flood alarms, are to be tested for their accuracy and operation by varying the process conditions (for example: High then low pressure) and simultaneously measuring and recording the information displayed by:

.1 An independent measuring instrument.

.2 The instrument switch.

.3 All remote lights and indicators.

3.3 I/O LOOP CHECKS

.1 I/O loop checks are to be performed for the complete loop where possible by exercising the field device and monitoring the input at the control panel.

.2 Where an instrument loop cannot be checked with the instrument functioning, a current generator shall be used to verify the continuity of the analog loop.

.3 Where a digital loop cannot be checked with the field device, a wire jumper is permitted to verify the continuity of the digital loop.

.4 PLC output loops shall be verified by forcing the corresponding output from the PLC program.

.5 Submit testing procedures and schedules of work no less than 1 month prior to the projected test date for the individual component. This will include specific dates for when the various test procedures are to be carried out and identify assistance from Owner’s staff if required.

.6 Review of the PLC panel on site to ensure that all panel FAT deficiencies have been corrected is to be completed prior to any filed wiring being completed. This review is to be coordinate with the Engineer and the sign off sheet completed.

.7 The Contractor is to conduct their own I/O check and instrument and equipment verification. Contractor completed and signed off I/O Checksheets and instrument and equipment verification sheets are to be completed and submitted to the Engineer for review.

.8 Contractor I/O check is not to be completed until no less that 90% of all I/O is wired, terminated, checked and verified at each PLC.

.9 The Engineer may, at their discretion, choose to witness a subsequent I/O check and instrument and equipment verification with the Contractor. Contractor and all required subcontractors will participate as required.

.10 Contractor shall provide I/O loop checks to the Engineer for review before SAT con commence. Once I/O loops have been reviewed and accepted by Engineer, SAT can be scheduled.

3.4 NETWORK CABLING TESTING

.1 Complete testing of each run of 100 BaseT cabling installed using "Cat 06" data test equipment. Provide a printed report for all test results, as well as an Adobe file of the results. Acceptable test equipment is: Fluke - 620 LAN.

.2 Complete testing of each run of fibre optic cabling installed using signal strength test set at 850 nm and 1300 nm. No more than 6 dB of loss in total (including cable, connectors and interconnections) between media converters is permitted. Provide a printed report for each test. Acceptable test equipment is: Fluke - FOM and FOS 850/1300.

.3 Demonstrate correction function of each network segment and complete network.

.4 Refer to Section 27 10 00 - Structure Cabling system for additional requirements.

3.5 COMMISSIONING

.1 Contractor shall provide qualified electricians and/or instrument technicians to assist the Systems Integrator with testing of the control system programming for the duration of commissioning.

.2 At the beginning of the commissioning period, the plant staff will be trained by the System Integrator. At the end of the training sessions, each Operations should have enough confidence and familiarity with the SCADA system to successfully operate the facility. It is critical that the Operations can comfortably interact with the SCADA system during the commissioning period.

.3 The system-commissioning period will be defined within the specification. During that period of time, the System Integrator shall provide technical support 24 hrs a day and 7 days a week. The System Integrator shall provide the Owner with all numbers required to provide a maximum of 1 hr response time. Response to all incidents will consist of verbal communication between the plant staff and the System Integrator. Four methods are available to remedy any problems that occur during the commissioning period:

.1 Log Book - If the System Integrator and Owner staff member agree that the incident does not have a critical impact on the process, it will be recorded and addressed by the System Integrator remotely or during the next site visit.

.2 Verbally - In most cases, the System Integrator will be able to explain the occurrence and offer the appropriate advice over the phone.

.3 Physical Presence - In the event that a solution cannot be provided over the phone or remotely, the System Integrator will go to site to remedy the situation.

3.6 SITE ACCEPTANCE TESTING (SAT)

.1 The SAT shall be scheduled once all I/O loop checks and the control system has been tested and commissioned.

.2 Contractor shall provide qualified electricians and/or instrument technicians to assist with the execution of all test cases during Site Acceptance Testing.

.3 Conduct SAT in the presence of Engineer, System Integrator, Electrician and any additional stakeholder to verify proper operation and integration of the system into the SCADA system as intended.

3.7 FINAL OVERALL TEST

.1 The final system test is performed by the System Integrator after the successful completion of the commissioning period and is witnessed by the Owner. At this stage, all the Operations should be competent in the operation of the system. The system should be functional and free of any errors. The final system test will be performed on site. All components will already be connected and should be functioning properly. The purpose of the final system test is to ensure that the system can perform all necessary tasks as outlined in the process control narrative. If there are any new or outstanding concerns, they will be addressed at this time. The only requirement of this test is to confirm to the Owner that the system is 100% complete. Upon the successful completion of the final system test, Owner will sign that they have witnessed the system working as outlined and that they are prepared to perform the system handover.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 The Factory Acceptance Test (FAT) demonstrates that all equipment, hardware, wiring and terminations are properly installed and configured.

1.2 OBJECTIVES

.1 The overall objectives of the Factory Acceptance Test are to:

.1 Confirm that the PLC control panel has been constructed and meeting Owner guidelines and all hardware operates as intended.

1.3 SUBMITTALS

.1 The following submittals are made during the FAT procedure:

.1 Submit the test plan: testing forms, procedures and schedules of work, not less than 2 weeks prior to the scheduled test date.

.2 Submit Panel Layouts, Loop Drawings, Power distribution, network schematics, Bill Of Materials and associated Control Panel documentation.

.3 Submit testing documentation including all testing scenarios to be undertaken.

.4 The test plan must be reviewed by the Engineer, prior to commencement.

.5 Factory Acceptance Test Report shall be submitted within 1 week after completion of FAT.

.6 Once Panel FAT has been completed, it is assumed that there will be no modifications. Only modifications to the address comments/deficiencies noted during the Panel FAT are to be completed. All deficiencies shall be addressed before shipping to site.

1.4 TESTING PROCESS

.1 The Panel Shop shall conduct the tests. Owner representative and the Engineer will actively participate in the tests. The Owner representative and Engineer reserves the right to test any specified hardware/software function whether or not explicitly stated in the test submittal.

.2 The Panel shop is to invite the following representatives of the following groups to attend the FAT:

.1 Facility Operations/Process End Users.

.2 Engineer.

.3 Make hardware and software fully operational.

.4 Have both, the Owner representative and Engineer review and approve test procedure.

.3 The FAT may be repeated as many times as required until the Engineer and Owner has deemed the final software product to be satisfactory to progressing to field implementation and the Site Acceptance Testing.

.4 Representatives of the panel shop, Owner and Engineer shall sign a panel FAT Sign-Off form to indicate completion of the tests. A deficiency list shall be submitted indicating required changes including a schedule for completion.

1.5 TESTING DOCUMENTATION

.1 Contractor shall develop the specific testing procedure based on the specific equipment, their operation and functionality of the system under test.

Part 2 Products

Not Used.

Part 3 Execution

Not Used.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 The PCS Site Acceptance Test (SAT) demonstrates that all SCADA and controller software and hardware are working properly and that all software configurations match the requirements identified in Detailed Software Design, including the detailed process narratives, operating manuals and logic flow chart diagrams, both confirmed in the Factory Acceptance Test.

.2 Test the software under all possible process conditions in order to ensure the software contains no defects. Include a wide range of operating scenarios, with all process setpoints, interlocks and alarm limits. In phased installation, test each process separately after completing the installation in the process. In addition, test the complete system performance after each of the processes have successfully passed their SAT.

1.2 SUBMITTALS

.1 The following submittals are made during the SAT procedure:

.1 Submit the test plan: Testing forms, procedures and schedules of work not less than 2 weeks prior to the scheduled test date. The test plan must be approved in writing by the Owner, prior to commencement.

.2 Submit copies of the FAT'd PLC program, HMI graphics, OIT graphics, SCADA database. Copies shall be provided in PDF format to provide markups as well as the files in their native format.

.3 Submit the Site Acceptance Test Report within 1 week after completion of SAT.

.4 Submit I/O checks for Engineer review to ensure equipment is properly connected and controlled and system is ready for testing

.5 On completion of the SAT, a locked down version of the HMI, OIT, PLC software will be submitted to the Owner for record. Once the SAT has been completed, it is assumed that there will be no modifications to any software to be integrated into the Plant system.

1.3 TESTING PROCESS

.1 The System Integrator shall conduct the tests. Owner representative and Engineer will actively participate in the tests. The Owner reserves the right to test any specified hardware/ software function whether or not explicitly stated in the test submittal.

.2 The System Integrator is to invite the following representatives of the following groups to attend the SAT;

.1 Facility Operations/Process End Users.

.2 Engineer.

.3 Additional System Integrator representatives.

.3 The System Integrator shall coordinate support as needed and the end user must attend the entire SAT and any possible subsequent SAT(s) as they sign off on all check lists.

.4 The System Integrator should meet the following criteria prior to the start of the tests:

.1 Complete submittals

.2 Make hardware and software fully operational.

.3 Have an Engineer and Owner representatives reviewed and approved test procedure.

.5 HMI, OIT and PLC software will be loaded into the SAT testing equipment prior to deployment on the live system.

.6 Limit testing, in general, to 7 hrs per day. Hold a meeting each morning to review the day's test schedule and a meeting each evening to review the day's test results and review or revise the next day's test schedule. At the completion of the test, meet to review the list of deficiencies. All deficiencies must be corrected prior to Substantial Performance.

.7 At the completion of the SAT it is the responsibility of the System Integrator, Owner representative and Engineer to sign-off all forms pertaining to the testing of the modified system.

1.4 TESTING DOCUMENTATION

.1 Prepare Site Acceptance Test and Site Acceptance based on the Owner's FAT and SAT template Testing document (Attached for information only). System Integrator shall develop the specific testing procedure based on the specific equipment, their operation and functionality of the system under test. System Integrator should request document in its original format) showing the following information as a minimum:

.1 For all I/O points list the device tag name, PLC tag name, Description of point, I/O Address (if applicable), Date Verified, Comments and Issue Log Number.

.2 For field inputs and outputs also list, Device Range (Minimum, Maximum and Units), HMI Device Range (Minimum, Maximum and Units) and HMI Engineering Units Test (Minimum, Mid-range and Maximum).

.3 For analog input alarms list the Trip point for the alarm in percent of span, Engineering units, Time Delay, Operator Control (Adjust Trip point and Disable), Alarm area, alarm priority.

.4 For discreet input alarms also list, time delay, Operator Control (Disable), Alarm area, alarm priority.

.5 For all alarms show and test alarm are conditioned as documented in Process Control Narratives.

.6 For Virtual Points also list, read/write access, minimum value, maximum value, default value and units of measurement.

.7 For trend points also list trending attributes.

.8 For data Transferred between PLCs identify tagnames and descriptions.

.2 Testing procedure shall describe test operation of every individual device connected to the system as well as part of the overall system as a whole.

.3 Normal Device Operations:

.1 Local Mode Operations.

.2 Computer Manual Mode Operations.
.3 Transfer from Local to Computer.
.4 Transfer from Computer to Local.
.5 Computer Automatic Mode Operations.
.6 SCADA/Automation.

.4 Abnormal Device Operation:

.1 Uncommanded Operations.
.2 Unresponsive Commands.
.3 Device Operation Permissives.
.4 Device Alarms.
.5 Emergency Stop.
.6 Power failure.
.7 Process and equipment interlocks.

Part 2 Products

Not Used.

Part 3 Execution

END OF SECTION

APPENDIX A
City of Kenora Health & Safety Policy and Contractor Safety Program

The Corporation of the City of Kenora
Occupational Health and Safety Policy

The Corporation of the City of Kenora is committed to preventing occupational illness and injury in the workplace.

We recognize that an effective health and safety program, as indicated by following acceptable industry practices and compliance with legislative requirements, and communication of that program to all workers, will contribute to a reduced risk of injury or illness to workers.

We further recognize that health and safety is the shared commitment and responsibility of us all. Our program is based on the concepts of the Internal Responsibility System wherein responsibilities and authority for health and safety are delegated from the top down and accountability for performance is required from the bottom up.

The Senior Leadership Team is responsible for establishing health and safety policy and ensuring the development of a health and safety system.

Division Managers are responsible for the development and implementation of health and safety programs in their divisions and for ensuring that their Division Leads are performing their required health and safety responsibilities.

Division Leads and all supervisory personnel are responsible to enforce health and safety rules and regulations and to ensure that their workers have the appropriate training, skills, and qualifications to perform their tasks safely.

Workers are responsible to follow employer and regulatory procedures, use their initiative to reduce risk, and to report unresolved issues to their supervisor.

It is the intention of this policy that:

"No job is so important and no service is so urgent that we cannot take the time to perform our work safely"

Chief Administrative Officer **Mayor**

Approved by Municipal Council on March 16, 2021

Health and Safety Responsibilities - Contractors

Section Health and Safety Policies	**Date** March 19, 2012	**Approved by By-law Number:** 27-2012	**Page** 1	**Of** 4
Subsection Responsibilities and Accountabilities	**Supersedes By-law Number:** 105-2011		**Policy Number:** HS-05	

PURPOSE

It is the policy of the City of Kenora to require that the provisions of the Occupational Health and Safety Act (Act) and applicable Regulations are complied with:

- where the City of Kenora contracts the performance of work or services (non-construction); and
- where the City of Kenora contracts a "constructor" (as defined in section 1 of the Act) to undertake a project (construction).

The purpose of these requirements is to ensure that all reasonable precautions are taken:

- for the protection of workers; and
- so that the City of Kenora is duly diligent in their duties and responsibilities under the Act.

RESPONSIBILITY

Contract Personnel

Contract personnel are responsible to:

- comply with the requirements of this policy and guideline;
- use their training, knowledge and experience to protect the health and safety of themselves and others;
- report to their supervisor the absence of, or defect in any protective equipment or device; and
- report to their supervisor, any circumstances or conditions that may limit their ability to comply with the requirements of this policy and guideline.

Contractors

Contractors are responsible to:

- enforce and comply with the requirements of this policy and guideline; and
- ensure that their workers are aware of this policy and guideline.

Supervisors (Both City of Kenora and Contract Personnel)

Supervisors are responsible to ensure that:

- contract personnel (non-construction) work in compliance with the requirements of this policy and guideline;

- contract personnel (non-construction) are aware of the requirements of this policy and guideline;
- protective equipment and devices required to carry out the requirements of this policy and guideline are provided; and
- protective equipment and devices that are provided are maintained in good condition.

Management
Managers are responsible for ensuring all City of Kenora operations are in compliance with applicable legislation and the requirements of this policy and guideline.

PROCEDURE

General
All contractors are required where applicable, to provide to the City of Kenora upon request the following:
- WSIB certificate of clearance;
- third party liability insurance (minimum $2 million);
- where applicable, federal, provincial and municipal licensing, certification, notification, inspection and approvals;
- occupational health and safety policy and program;
- applicable training documentation for supervisors and workers as specified by The City of Kenora;
- hazardous materials and designated substance inventories; and
- records of health and safety violations and convictions under the Act.

Service Contractors (Non-construction)
In addition to the duties and responsibilities imposed on contractors under the Act, service contractors will ensure:
- the applicable requirements of the City of Kenora's health and safety program are communicated to, understood by and complied with by the workers of the contractor;
- the measures and procedures required by the Act and Regulations (applicable to the work) are carried out;
- appropriate documentation of instruction and communication are maintained and available for review by the City of Kenora; and
- any and all other precautions deemed necessary by the City of Kenora for safeguarding workers, equipment and property are carried out.

The City of Kenora will gauge contractor compliance with these requirements, and reserves the right to terminate services' contracts for any and all violations.
Contractors (and their workers) are required to attend any and all safety related meetings as deemed appropriate by the City of Kenora.

Project Contractors (Construction Projects)
In addition to the duties and responsibilities imposed on contractors (who undertake a construction project for the City of Kenora) under the Act, contractors will ensure:

- the City of Kenora's health and safety requirements for contractors (construction) are incorporated into the project health and safety program;
- a project hazard assessment review is conducted, prepared and submitted to the City of Kenora which includes;
    - analysis and evaluation of hazards;
    - application of controls;
    - instruction and information provided to supervisors and workers regarding hazards;
    - hazardous materials inventory;
    - operational, maintenance and emergency procedures specific to the project assessment; and
    - training in the necessary procedures;
- a written health and safety policy is available, posted and communicated to all workers on the project;
- a project safety program is developed and implemented that details how the contractor will ensure compliance with subsections 23(1), 25(1) and 25(2) of the Act;
- a designated safety representative coordinates health and safety on the project; and
- the designated safety representative attends a project pre-meeting with representatives of the City of Kenora.

Equipment
The contractor is responsible to provide, maintain and ensure that all equipment necessary, including personal protective equipment, is properly used or worn for the duration of the work.
All equipment used by the contractor shall conform to the manufacturer's specifications and comply with all applicable legislation. The City of Kenora reserves the right to prohibit the use of any equipment, methods or practices that do not conform to acceptable standards. Equipment shall be removed from the City of Kenora's premises immediately upon completion of the work.

TRAINING

All City of Kenora personnel involved with contracting of work will be made aware of the contents of this policy. All training will be documented.

REFERENCES

Occupational Health and Safety Act (Ontario) – Section 23
Wrokwell Core Health and Safety Audit – Element 2.1 (i) and (j)

City of Kenora
Contractor Safety Program

Introduction

The City of Kenora is committed to the health and safety of all of our employees, and expects the same commitment from each contractor to their own employees.

The City of Kenora has developed this program for use by all contractors who perform work or provide services on City of Kenora premises. Contractors include all on-site service providers, construction contractors and all sub-contractors. Outside carriers, delivery, or pick-up personnel are generally not required to complete the Contractor Safety Program requirements unless the scope of the service that they provide will go beyond the routine delivery or pick-up of commodities at approved points within the City of Kenora. Outside Trainers or Consultants generally are not required to complete the Contractor Safety Program requirements unless the scope of the service that they provide will include health and safety hazards.

This program does not cover all of the site-specific or even project-specific health and safety issues that may arise. This program is by no means meant to be all inclusive of the requirements of the *Occupational Health and Safety Act* (hereinafter referred to as the *Act*) or any other applicable legislation.

The Contractor Safety Program consists of three elements:

1. The General Workplace Safety Requirements for Contractors

This section is a compilation of the specific information that Contractors need to know before and be aware of during the performance of work for the City of Kenora in order to ensure compliance with the program. Not all information in this section applies to all contractors. It is up to individual contractors to review this section and understand the applicable sections based on the work or service that they will be providing to the City of Kenora.

2. Contractor Declaration and Documentation Requirements Checklist

Prior to performing work for the City of Kenora, all new contractors must complete the Contractor Declaration and submit the documentation required as outlined on the form to the City Representative. The declaration must be signed by a representative of the Contractor who has the authority to commit the Contractor to comply with the General Workplace Safety Requirements for Contractors.

3. City of Kenora Contractor Orientation Checklist

It is the Contractor's responsibility to review the General Workplace Safety Requirements for Contractors document with their employees.

Prior to work commencing, the City Representative must complete the orientation checklist with the Contractor. This session will outline the site specific hazards, and emergency and reporting procedures.

City of Kenora

General Workplace Safety Requirements for Contractors

1. Unless explicitly referenced elsewhere in contract documentation, the Contractor will be designated as the Constructor, as defined by the *Act*, for the purposes of construction project work. As Constructor the Contractor will assume all of the responsibilities as set out in the *Act* and its regulations and shall enforce strict compliance therewith.

2. The Contractor must have an Occupational Health and Safety Policy and a program to implement that policy.

3. The Contractor shall ensure that work is conducted in a safe manner consistent with the intent of the *Act*, and any other Act, regulation, or by-law. Violations of any such legislation may result in the Contractor being removed from the project.

4. The Contractor shall appoint a person to supervise the work and that person shall be a *competent person*, as defined by the *Act*. The Contractor shall provide documentation to the City's Representative as evidence of the individual's competence. This could include training records or other such documentation as may be appropriate.

5. During the execution of the work, the Contractor shall ensure that:

a) worker safety is given first priority in planning, pricing, and performing the work;

b) its officers and supervisory employees have a working knowledge of the duties of a constructor and employer as defined by the Act and the provisions of the regulations applicable to the work, and a personal commitment to comply with them:

c) a copy of the most current printing of the Act and applicable regulations are available at the Contractor's office within the working area or, in the absence of an office, in the possession of the supervisor responsible for the performance of the work;

d) workers employed to carry out the work must possess the knowledge, skills, and protective devices required by law or recommended by a recognized industry association to allow them to work safely;

e) its supervisory employees are competent person as defined by the Act and they carry out their duties in a diligent and responsible manner with due consideration for the health and safety of the workers;

f) all subcontractors and their employees are properly protected from injury and illness while they are at the workplace.

6. Where required by the Act and its regulations, the Contractor shall register the project with the Ministry of Labour's Construction Health and Safety Branch prior to starting work on the site. The Contractor shall pay all registration fees. A copy of the registration must be posted in a visible location at the site, and submitted to the City's Representative before starting work on site.

7. The Contractor shall have a written emergency plan, which includes a process for addressing critical injuries, accidents, and incidents as required by sections 51, 52, and 53 of the Act/ The plan must be readily available. If work is on a project, the emergency plan shall be posted on site prior to any work commencement.

8. Where required, the contractor shall provide a telephone, appropriate first aid facilities, eye wash stations and any other measures required for emergency use as identified in the emergency plan.

9. The contractor shall conduct regular workplace inspections in accordance with the Act. The contractor must immediately address any preventive or corrective measures required to maintain site safety.

10. The contractor shall, throughout the course of the work, make the City's representative aware of all accidents/incidents that occur involving the contractor or the contractor's employees.

11. The City's representative will stop the work immediately for any violation of the Act or regulations that they become aware of. The contractor shall not resume the work until any such violation has been rectified.

12. The contractor shall be responsible for any delay in the progress of the work due to a violation of legislated requirements or City health and safety requirements of which the contractor has been advised, and shall take the necessary steps to avoid delay in the final completion of the work without additional cost to the City.

Declaration

I have received and read the "City of Kenora Contractor Safety Program". As the owner or authorized representative of the contracted services, I understand that I am fully responsible for ensuring that all of our employees, subcontractors, and visitors comply with all necessary rules and regulations outlined therein and with all applicable regulations made under the Occupational Health and Safety Act.

Name: _____

Signature: _____

Company Name: _____

Witness: _____

Contractor Document Requirements

The documentation required from the contractor will be dependent on the scope of the work to be performed. Prior to commencement of work the contractor will be advised as to which of the following documentation will need to be provided to the City of Kenora Representative for review. This list is not intended to be all inclusive and additional documentation may be requested at the discretion of the City of Kenora Representative.

- □ Contractor Safety Policy
- □ Certificate of Liability Insurance
- □ Valid WSIB Clearance Certificate
- □ Certificate of Personal Disability Coverage
- □ Supervisor's Name and Phone Number
- □ Contractor's List of First Aiders
- □ Contractor's Emergency Contact Numbers
- □ Training Records Supporting Competency of Supervisor
- □ Approved Registration Form (As per Section 5 of O. Reg. 213/91)
- □ Notice of Project Form if Required (As per Section 6 of O. Reg. 213/91)
- □ Generator Registration Number (if removing hazardous waste)

_____	_____
City Representative Name	Owner of the Contracted Services
_____	_____
Signature of City Representative	Signature of Owner

Contractor Initial Orientation

Prior to any "work" being done by the contractor, an initial orientation must be held. The City Representative shall conduct this orientation. Work must never begin before the orientation has taken place and information is conveyed to all contractor employees. If all contractor employees are not present for the orientation, it is the responsibility of the Contractor Representative to convey this information to the contractor employees.

Where there is an established scope of work, location, conditions, hazards, and they will not change during a twelve-month period, then a yearly orientation can be held.

The City's Representative is to review and check off the following items with the contractor:

- □ Inform the contractor of the Health and Safety hazards or requirements of the area in which they will be working. The contractor site supervisor (or appropriate designate) is responsible to convey this information to all contract personnel working on the project or job.

- □ The City of Kenora emergency procedures and evacuation procedures as they apply to the work being performed.

_____ _____
City Representative Name Contractor Name

_____ _____
City Representative Signature Contractor Signature

_____
Date

Appendix

Internal Procedures for Hiring Contractors

The City of Kenora is committed to the health and safety of all our employees and expects the same commitment from each contractor to their own employees.

A City representative is the point of contact for the contractor while performing work for the City of Kenora.

Definitions (from the Occupational Health and Safety Act)

Competent person means a person who:
(a) is qualified because of knowledge, training and experience to organize the work and its performance,
(b) is familiar with this Act and the regulations that apply to the work, and
(c) has knowledge of any potential or actual danger to health or safety in the workplace.

Construction includes erection, alteration, repair, dismantling, demolition, structural maintenance, painting, land clearing, earth moving, grading, excavating, trenching, digging, boring, drilling, blasting, or concreting, the installation of any machinery or plant, and any work or undertaking in connection with a project but does not include any work or undertaking underground in a mine.

Maintenance vs. Construction – According to the Ministry of Labour's Construction vs. Maintenance Policy, contract work is considered construction if the contract activities are mentioned in the definition of construction and are performed on objects mentioned in the definition of project. Those construction activities not performed on objects mentioned in the definition of project would be considered maintenance and would be covered by the industrial regulations. For example, an alteration, repair, or dismantling performed on a building, bridge, or structure, is construction, whereas the same activities carried out on machinery or equipment would be maintenance. Similarly, structural maintenance and installations are considered to be construction, whereas routine plant maintenance is considered to be maintenance.

Constructor means a person who undertakes a project for an owner and includes an owner who undertakes all or part of a project by himself or by more than one employer.

Employer means a person who employs one or more workers or contracts for the services of one or more workers and includes a contractor or subcontractor who undertakes with an owner, constructor, contractor, or subcontractor to perform work or supply services.

Owner includes a trustee, receiver, mortgagee in possession, tenant, lessee, or occupier of any lands or premises used or to be used as a workplace, and a person who acts for or on behalf of an owner as an agent or delegate.

Project means a construction project, whether public or private, including;
(a) the construction of a building, bridge, structure, industrial establishment, mining plant, shaft, tunnel, caisson, trench, excavation, highway, railway, street, runway, parking lot, coffer dam, conduit, sewer, water-main, service connection, telegraph, telephone or electrical cable, pipe line, duct or well, or any combination thereof,

(b) the moving of a building or a structure, and
(c) any work or undertaking, or any lands or appurtenances used in connection with construction.

Supervisor means a person who has charge of a workplace or authority over a worker.

Worker means a person who performs work or supplies services for monetary compensation but does not include an inmate of a correctional institution or like institution or facility who participates inside the institution or facility in a work project or rehabilitation program.

Workplace means any land, premises, location or thing at, upon, in or near which a worker works.

Procedure

For all contracts for services:

- Determine the nature of the work
- Determine the health and safety hazards, and
- Classify the contract work.

a) A construction project that has significant health and safety hazards. Examples would include but are not limited to construction of a community centre, renovations, replacement of a boiler and other major equipment.

b) Maintenance with significant health and safety hazards. Examples would include but are not limited to window washing, annual inspection of roof top anchors, replacement of heating coils, or electrical repairs.

c) No significant health and safety hazards. Examples would include but are not limited to photocopier maintenance and using external training consultants.

For tender contracts it will be the responsibility of the department issuing the tender to obtain the required information from the contractors. For contracts that are not tendered, the City Representative will be responsible for obtaining this information.

For the contracts classified with health and safety hazards, those contractors must be given a copy of the City of Kenora Contractor Safety Program. The contractor must complete the Contractor declaration portion of this document and provide the City's Representative with the required documentation prior to the work commencing.

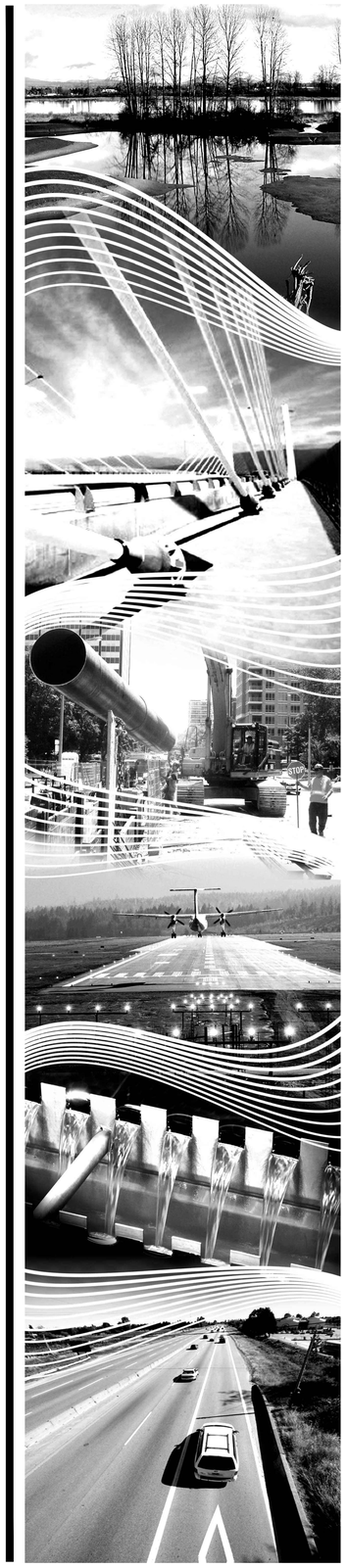
At the beginning of the work the City's Representative will be responsible to provide the contractor with the appropriate orientation which will include;

- Identification of all known hazards
- A walk through of the work area, and
- Locations of all emergency exits and the procedure for evacuation. (If applicable to the work being performed.)

If at any time a contractor is observed performing work unsafely or contrary to the Act or regulations this must be addressed immediately. The contractor must be made to stop what they are doing and the contractor will not resume the work until such contraventions have been rectified.

SHEET LIST TABLE

SHEET	DRAWING NAME	REVISION	DRAWING TITLE	DRAWING DESCRIPTION
GENERAL				
1	5884-00-G-001	0	COVER SHEET	
CIVIL				
2	5884-00-C-101	0	EXISTING SITE PLAN	WWTP
STRUCTURAL				
3	5884-00-S-101	0	PLAN AND SECTION	AEROBIC DIGESTER BUILDING 400
4	5884-00-S-102	0	EXISTING SECOND FLOOR PLAN	SCREW PUMP BUILDING 200
5	5884-00-S-201	0	EXISTING SOUTH ELEVATION	SCREW PUMP BUILDING 200
MECHANICAL				
.	5884-00-M-001	0	LEGEND	
7	5884-00-M-101	0	EXISTING UPPER AND LOWER LEVEL PLANS	VENTILATION - SCREW PUMP BUILDING 200
8	5884-00-M-102	0	EXISTING BASEMENT AND GROUND FLOOR PLANS	VENTILATION - DIGESTER CONTROL BUILDING 400
ELECTRICAL				
9	5884-00-E-001	0	LEGEND	
10	5884-00-ED-101	0	EXISTING FLOOR PLANS - DEMOLITION	SCREW PUMP BUILDING AND DIGESTER BUILDING
11	5884-00-ED-501	0	EXISTING PHOTOS - DEMOLITION	SCREW PUMP BUILDING AND DIGESTER BUILDING
12	5884-00-E-101	0	EXISTING SITE PLAN	POWER
13	5884-00-E-102	0	EXISTING UPPER AND LOWER LEVEL PLANS	POWER - SCREW PUMP BUILDING 200
14	5884-00-E-103	0	EXISTING BASEMENT AND MAIN FLOOR PLAN	POWER - DIGESTER CONTROL BULDING 400
15	5884-00-E-501	0	DETAILS	
16	5884-00-E-502	0	PHOTOS	EXISTING SCREW PUMP AND DIGESTER BUILDING
17	5884-00-E-601	0	SCHEMATICS	STARTER CONTROL
18	5884-00-E-602	0	SCHEMATIC	EXHAUST FAN CONTROL PANEL
19	5884-00-E-603	0	SCHEMATICS	STARTER CONTROL
20	5884-00-E-604	0	SCHEMATICS	
INSTRUMENTATION				
21	5884-00-EI-501	0	ACP PANEL LAYOUT	
22	5884-00-EI-502	0	PLC CONTROL PANEL LAYOUT	
23	5884-00-EI-601	0	DIAGRAM	PLC POWER DISTRIBUTION
24	5884-00-EI-602	0	DIAGRAM	RACK 0 SLOT 2 DIGITAL INPUT MODULE
25	5884-00-EI-603	0	DIAGRAM	RACK 0 SLOT 3 DIGITAL INPUT MODULE
26	5884-00-EI-604	0	DIAGRAM	RACK 0 SLOT 4 DIGITAL INPUT MODULE
27	5884-00-EI-605	0	DIAGRAM	RACK 0 SLOT 5 DIGITAL INPUT MODULE
28	5884-00-EI-606	0	DIAGRAM	RACK 0 SLOT 6 DIGITAL OUTPUT MODULE
29	5884-00-EI-607	0	DIAGRAM	RACK 0 SLOT 7 DIGITAL OUTPUT MODULE
30	5884-00-EI-608	0	DIAGRAM	RACK 0 SLOT 8 ANALOG INPUT MODULE
31	5884-00-EI-609	0	DIAGRAM	RACK 0 SLOT 9 ANALOG INPUT MODULE
32	5884-00-EI-610	0	DIAGRAM	RACK 0 SLOT 10 ANALOG OUTPUT MODULE



Associated Engineering

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Lake of the Woods KENORA

CITY OF KENORA
KENORA WASTE WATER TREATMENT PLANT
BUILDING 200 AND 400 ELECTRICAL UPGRADES

Issued for Tender - June 2025

CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	K. ANDERSON	C. HENDRICKS	ISSUED FOR TENDER

DRAWING	REVISION	SHEET
5884-00-G-001	0	1

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50 mm

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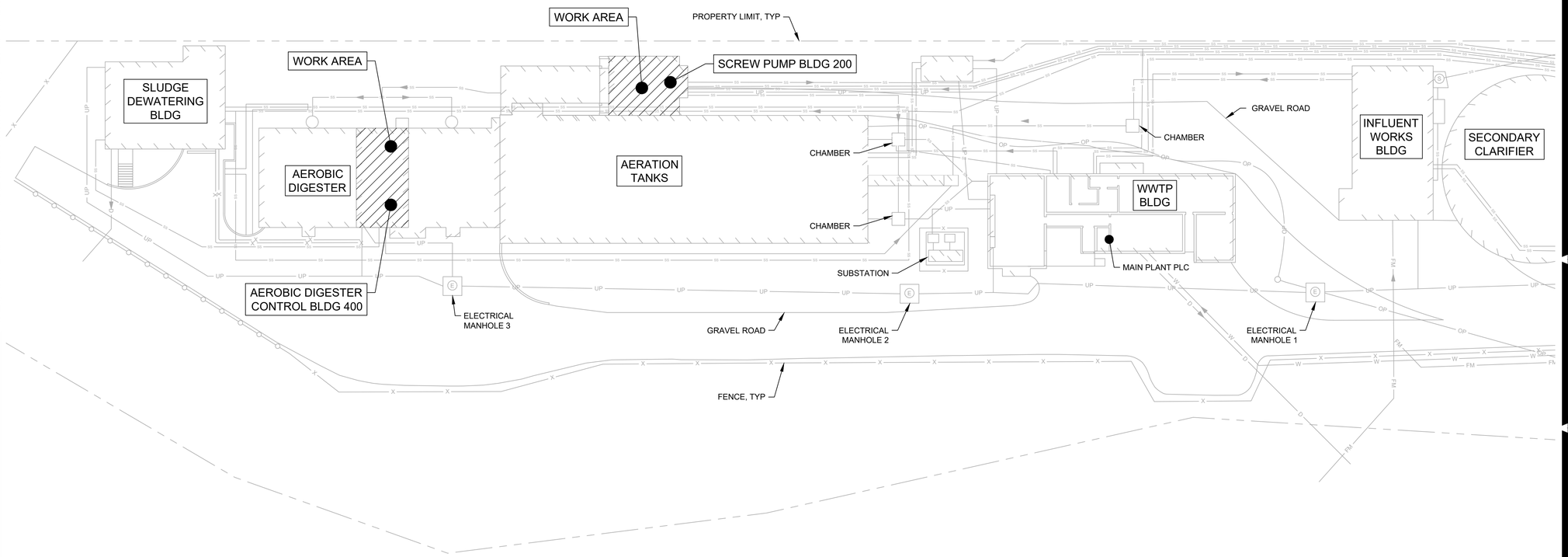

1 - PLAN 1:300

EXISTING SITE - WWTP

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0	2025MAY28	K. ANDERSON	C. HENDRICKS	ISSUED FOR TENDER

CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

CIVIL
EXISTING SITE PLAN
WWTP

DRAWING	REVISION	SHEET
5884-00-C-101	0	2

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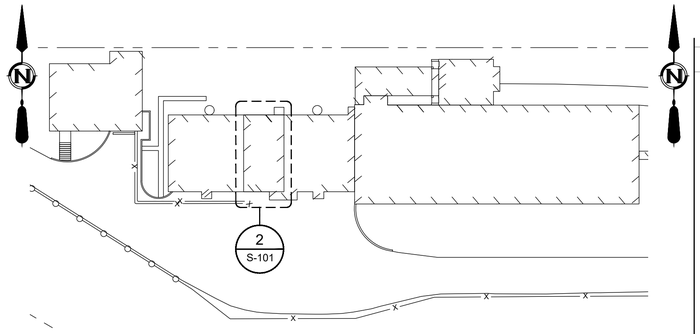


1 S-101 **PLAN** 1:500
KEY

NOTES:

1. GENERAL

1.1. THE GENERAL NOTES AND STRUCTURAL TYPICAL DETAILS ARE GENERAL AND APPLY TO THE ENTIRE PROJECT UNLESS NOTED OTHERWISE.

1.2. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS, ELEVATIONS AND EXISTING SITE CONDITIONS PRIOR TO PROCEEDING ANY FABRICATION AND CONSTRUCTION.

1.3. DRAWINGS SHALL NOT BE SCALED.

1.4 ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE NOTED.

1.5. ALL EXISTING FACILITIES SHALL REMAIN OPERATIONAL WITHOUT PRIOR SHUT DOWN APPROVAL FROM THE CITY. IT IS CONTRACTOR'S RESPONSIBILITY TO COORDINATE WITH THE CITY TO OBTAIN A SHUT DOWN PERMIT.

1.6. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE ONTARIO OCCUPATIONAL HEALTH AND SAFETY ACT, INCLUDING ERECTION, ALTERATION, REPAIR, DISMANTLING, DEMOLITION, STRUCTURAL MAINTENANCE, PAINTING, LAND CLEARING, EARTH MOVING, GRADING, EXCAVATING, TRENCHING, DIGGING, BORING, DRILLING OR CONCRETING, INSTALLATION OF ANY MACHINERY OR PLANT AND ANY WORK OR UNDERTAKING IN CONNECTION WITH THE PROJECT.

1.7. CONTRACTOR IS RESPONSIBLE FOR RESTORATION OF ALL DISTURBED AREAS BACK TO ORIGINAL CONDITIONS OR BETTER AFTER COMPLETION OF WORK.

1.8. CONTRACTOR IS RESPONSIBLE FOR ALL TEMPORARY BRACING AND SUPPORTS FOR ALL SLABS, BEAMS, WALLS AND FRAMES. TEMPORARY BRACING AND SUPPORT MUST BE CAPABLE OF TRANSFERRING ALL IMPOSED CONSTRUCTION AND DEAD LOADS TO THE STRUCTURE WITHOUT EXCEEDING STRUCTURAL CAPACITIES.

1.9. STRUCTURAL DIMENSIONS CONTROLLED BY OR RELATED TO PROCESS, OR MECHANICAL EQUIPMENT SHALL BE VERIFIED BY CONTRACTOR PRIOR TO CONSTRUCTION.

1.10. SEE OTHER CONTRACT DRAWINGS AND COORDINATE FOR ACTUAL SIZES, LOCATIONS AND DETAILS OF OPENINGS FOR PIPES, SLEEVES, DUCTS, AND OTHER PENETRATIONS NOT SHOWN ON STRUCTURAL DRAWINGS.

1.11. TYPICAL STRUCTURAL DETAILS SHALL BE USED WHERE SPECIFIC DETAILS ARE NOT SHOWN ON STRUCTURAL DRAWINGS. IF THE DETAILS DIFFER ON OTHER DRAWINGS OR SPECIFICATIONS, THE MOST STRINGENT SHALL GOVERN.

1.12. DO NOT CUT OPENING THROUGH STRUCTURAL ELEMENTS UNLESS APPROVED BY ENGINEER.

1.13. BEFORE ANY DRILLING, CORING, CUTTING OR CHIPPING AT ANY LOCATION ARE ALLOWED TO PROCEED, THE CONTRACTOR SHOULD CONDUCT MAPPING OF REBAR & OTHER EMBEDDED ITEMS. MAPPING DOCUMENTATION SHOULD BE SUBMITTED TO ENGINEER FOR REVIEW. THE FULL COST OF MAPPING SERVICES REQUIRED ON THIS CONTRACT SHALL BE INCLUDED IN THE TOTAL CONTRACT PRICE.

1.14. SUBMIT SHOP DRAWINGS TO ENGINEER FOR REVIEW AND APPROVAL PRIOR TO FABRICATION AND INSTALLATION.

2. EXISTING STRUCTURE

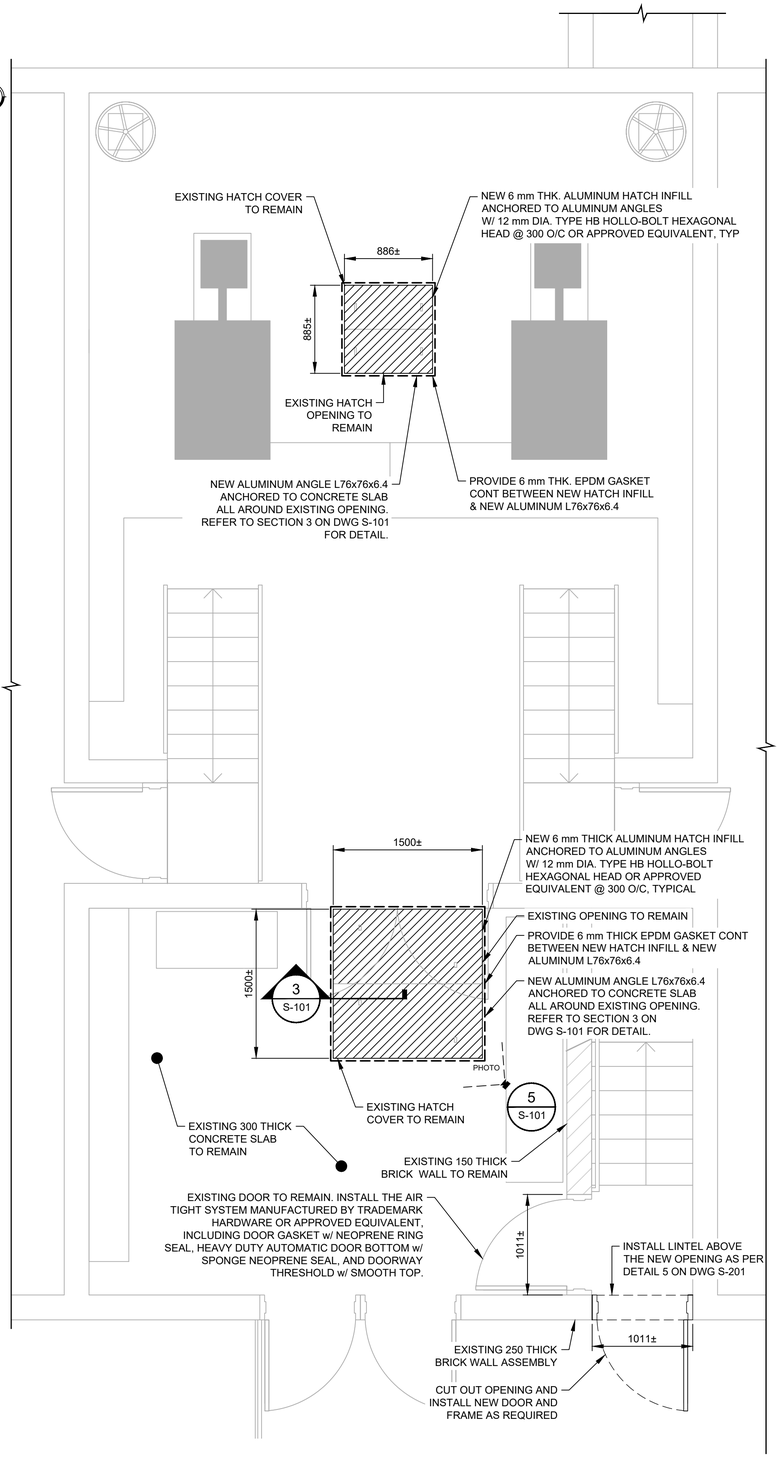
2.1. EXISTING STRUCTURAL INFORMATION IS BASED UPON DRAWINGS ISSUED BY PROCTOR & REDFERN LIMITED, DATED MAY 1977.

2.2. TAKE ALL PRECAUTIONS NECESSARY TO PROTECT THE EXISTING STRUCTURE DURING CONSTRUCTION.

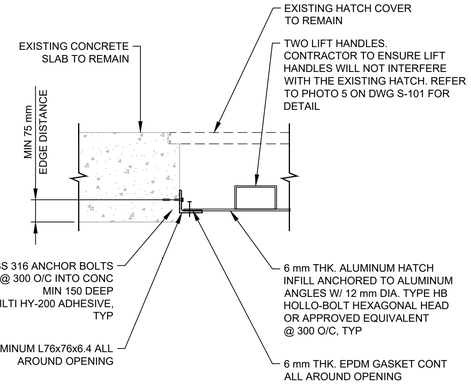
2.3. UNDERTAKE CHIPPING, CUTTING, CORING, REPAIRS, PATCHING, AND REMOVAL OF DEBRIS. MAKE CUTS WITH THE PROPER SAWS AND BITS WHEN A CLEAN LINE IS REQUIRED.

2.4. EXISTING DRAWINGS CONDITIONS ARE ASSUMED. REPORT ANY VARIATIONS TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

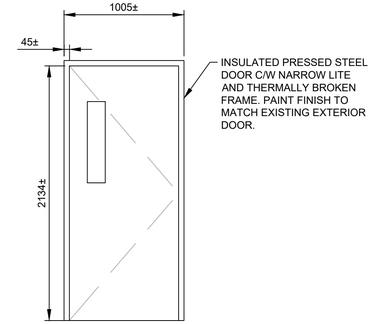
2.5. MAKE GOOD ONCE STRUCTURAL WORK IS DONE AND REVIEWED.



2 S-101 **PLAN** 1:30
EXISTING MAIN FLOOR - AEROBIC DIGESTER CONTROL BUILDING 400



3 S-101 **SECTION** 1:10
EXISTING HATCH INFILL



NOTES:

1. ALL HARDWARE PER SPECIFICATIONS.
2. GENERAL CONTRACTOR TO SITE CONFIRM NEW DOOR LOCATION.

4 S-101 **DETAIL** 1:10
NEW DOOR AND FRAME

5 S-101 **PHOTO** NTS
UNDERSIDE OF EX. HATCH

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100539351
2025-05-28
PROVINCE OF ONTARIO

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CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

STRUCTURAL
PLAN AND SECTION
AEROBIC DIGESTER BUILDING 400

DRAWING	REVISION	SHEET
5884-00-S-101	0	3

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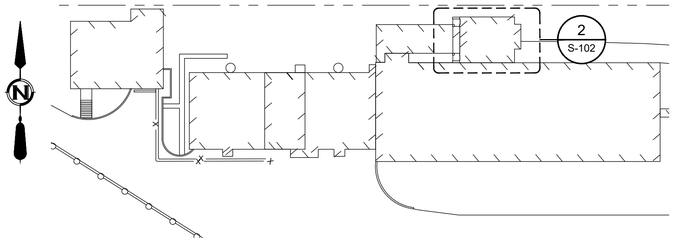
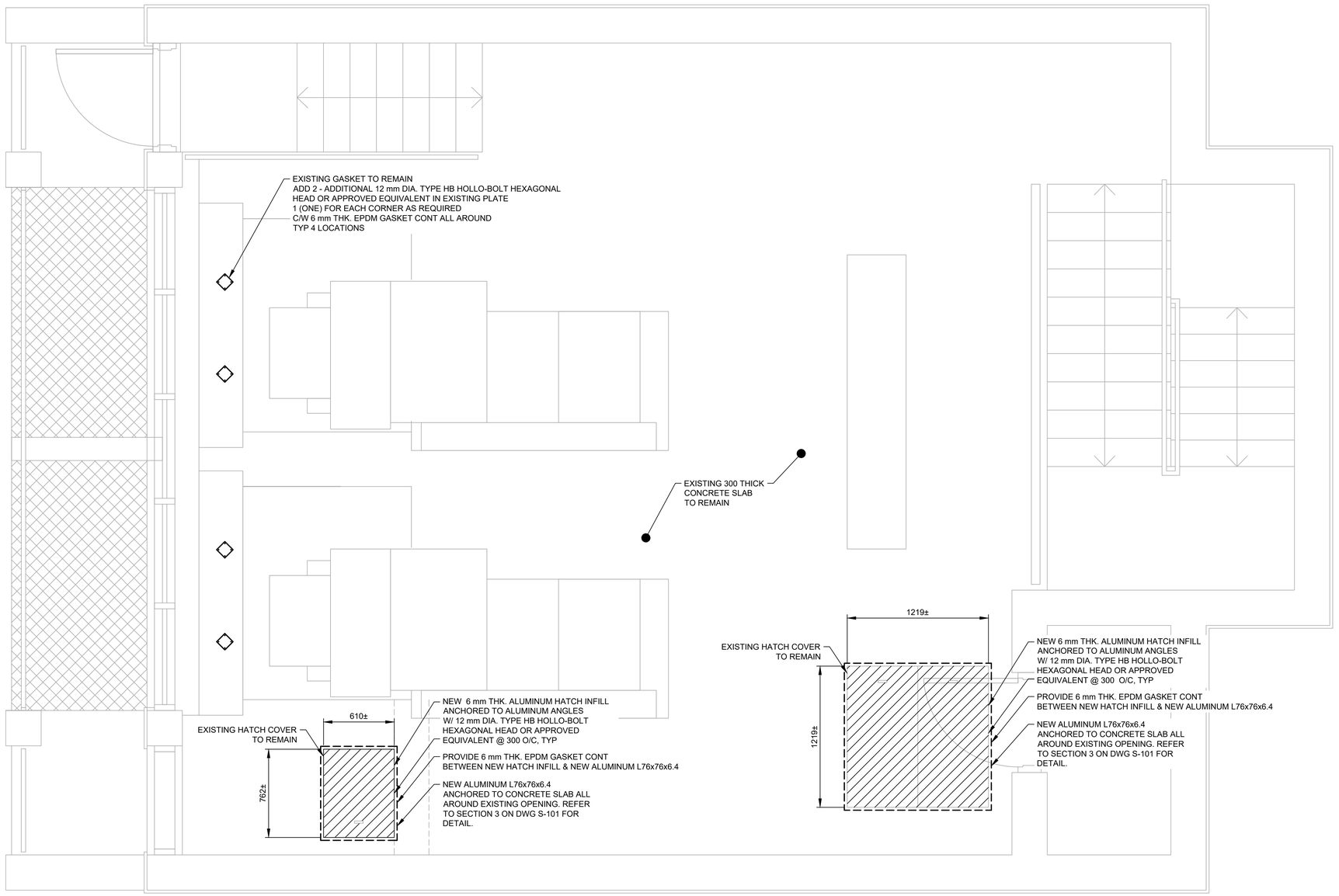


1 S-102 PLAN 1:500
KEY



2 S-102 PLAN 1:20
EXISTING SECOND FLOOR - SCREW PUMP BUILDING

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Z. ZHANG
100539351
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SCALE: 1:20

STRUCTURAL
EXISTING SECOND FLOOR PLAN
SCREW PUMP BUILDING 200

DRAWING	REVISION	SHEET
5884-00-S-102	0	4

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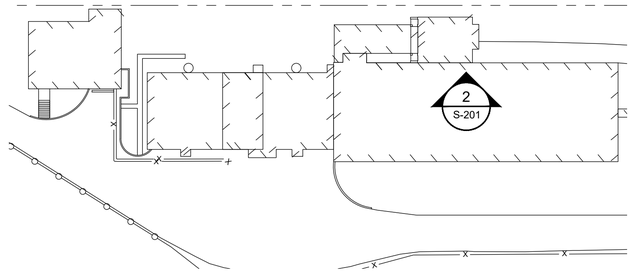
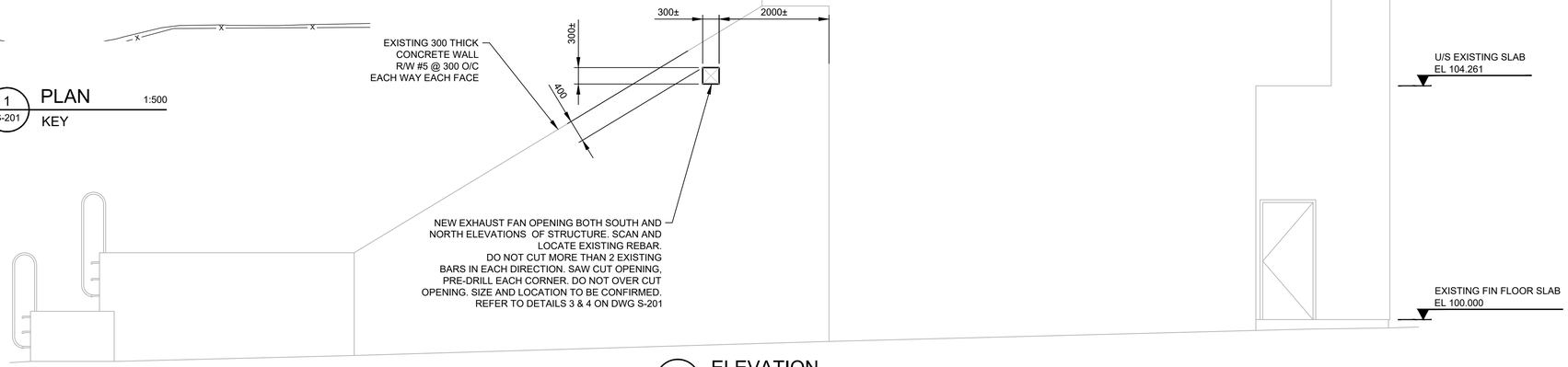
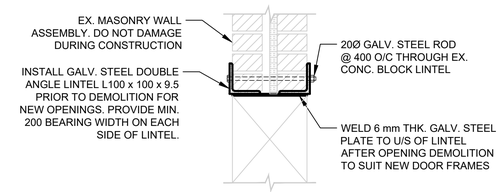


1 S-201 **PLAN** 1:500
KEY



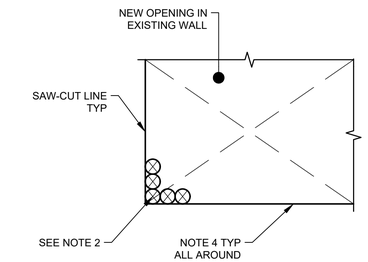
2 S-201 **ELEVATION** 1:50
SOUTH ELEVATION
EXISTING SCREW PUMP BUILDING 200



NOTES:

1. BEARING LENGTH: 200 MINIMUM EACH END (ANGLE LINTELS).
2. ALL STEEL ANGLE LINTELS SHALL BE HOT DIP GALVANIZED.
3. WRAP ENDS OF ANGLE WITH 6 MIL POLYETHYLENE SHEET AND SET ON 10 GA. GALVANIZED STEEL PLATE ON MASONRY, EACH END.
4. CONTRACTOR SHALL VERIFY THE EXISTING DOOR OPENING ON SITE AND REUSE IT TO ACCOMMODATE THE INSTALLATION OF NEW DOOR FRAME. REPORT TO THE ENGINEER OF RECORD OF ANY DISCREPANCY PRIOR TO CONSTRUCTION.

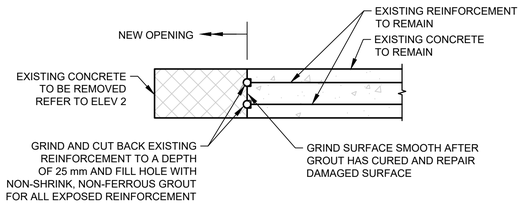
5 S-201 **DETAIL** NTS
LINTEL DETAIL FOR OPENING ON EX. MASONRY WALL



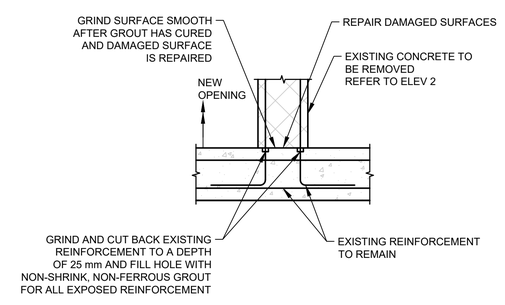
NOTES:

1. LOCATE ALL EXISTING UTILITIES LOCATED WITHIN DEMOLITION AREA IF PRESENT. REPORT TO CONTRACT ADMINISTRATOR IF ANY UTILITIES FOUND.
2. PRIOR TO SAW CUTTING NEW OPENING, DRILL 25 mm DIAMETER HOLES IN ALL CORNERS TO PREVENT OVERCUTTING. STAY WITHIN LIMITS OF OPENING AND DO NOT OVERCUT.
3. BURN BACK OR GRIND EXPOSED REINFORCING 25 mm AND DRY PACK WITH NON-SHRINK, NON-FERROUS GROUT. SEE DETAIL 4/S-201
4. FINISH EXPOSED SURFACE OF CONCRETE TO MATCH EXISTING.

3 S-201 **DETAIL** 1:5
NEW OPENING IN EXISTING WALL / SLAB

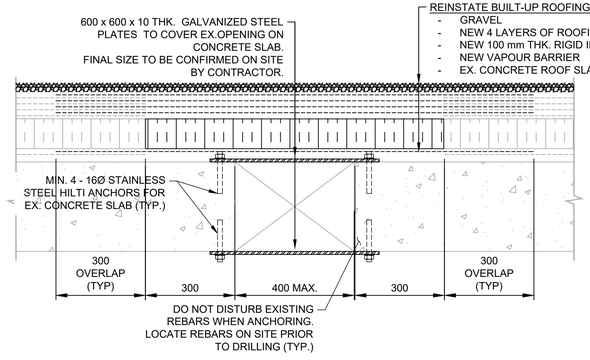


PLAN / SECTION



PLAN / SECTION

4 S-201 **DETAIL** 1:20
NEW OPENING IN EXISTING WALL / SLAB



6 S-201 **DETAIL** NTS
COVER PLATE FOR EX. ROOF OPENING

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20245884-00

SCALE: AS SHOWN

STRUCTURAL
EXISTING SOUTH ELEVATION
SCREW PUMP BUILDING 200

DRAWING	REVISION	SHEET
5884-00-S-201	0	5

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HEATING, VENTILATION AND A/C SYMBOLS

- AIR MOVEMENT ARROW
- DROP — RECTANGULAR SUPPLY/OUTDOOR AIR DUCT RISE
- DROP — ROUND SUPPLY/OUTDOOR AIR DUCT RISE
- DROP — RECTANGULAR RETURN/TRANSFER AIR DUCT RISE
- DROP — ROUND RETURN/TRANSFER AIR DUCT RISE
- DROP — RECTANGULAR EXHAUST/RELIEF AIR DUCT RISE
- DROP — ROUND EXHAUST/RELIEF AIR DUCT RISE
- DUCT CAP-OFF
- ROUND DUCT CONTINUATION
- RECTANGULAR DUCT CONTINUATION
- VD — SIDEWALL SUPPLY/EXHAUST/ RETURN GRILLE
- FLEXIBLE DUCT CONNECTION
- THERMALLY INSULATED DUCT
- ACOUSTICALLY INSULATED DUCT
- DROP SLOPE DROP
- DROP SLOPE RISE
- VD — VOLUME/BALANCING DAMPER, MANUAL
- BDD — BACKDRAFT DAMPER
- FD — FIRE DAMPER - VERTICAL
- FD — FIRE DAMPER - HORIZONTAL
- SD — SMOKE DAMPER - VERTICAL
- SD — SMOKE DAMPER - HORIZONTAL
- FSD — FIRE AND SMOKE DAMPER, VERTICAL
- FSD — FIRE AND SMOKE DAMPER, HORIZONTAL
- M — MOTORIZED DAMPER, PARALLEL BLADE
- M — MOTORIZED DAMPER, OPPOSED BLADE
- EXHAUST/RETURN WALL GRILLE
- SUPPLY WALL GRILLE
- DOOR GRILLE
- TRANSFER AIR OPENING
- SWITCH
- H — HUMIDISTAT
- H — HUMIDITY SENSOR

HEATING, VENTILATION AND A/C SYMBOLS

- T — THERMOSTAT
- T — TEMPERATURE SENSOR
- T — THERMOSTAT C/W GUARD AND INSULATED BACKPLATE
- P — PRESSURE SENSOR
- CO — CARBON DIOXIDE SENSOR
- CO — CARBON MONOXIDE SENSOR
- NO — NITROGEN DIOXIDE SENSOR
- AIR OUTLET OR INLET TAG
  - X-1 — TYPE
  - 200Ø — SIZE (mm)
  - 100 L/s — CAPACITY (L/s)
  - (TYP OF X)
- PERIMETER HEATING TAG
  - XX-1 — TYPE
  - 2130 — SIZE (mm)
  - 0.77 kW — CAPACITY (kW)
- EQUIPMENT TAG
  - XX-1 — EQUIPMENT TAG ABBREVIATION
  - (TYP OF X)

GENERAL SYMBOLS

- 1 — KEYNOTE

PIPING SYMBOLS

- 150-DCW — PIPE SIZE AND COMMODITY
- 80-SAN @ 1% — PIPE SIZE, COMMODITY AND SLOPE
- DIRECTION OF FLOW
- REDUCER
- FLEXIBLE PIPE CONNECTION
- PIPE ELBOW UP
- PIPE ELBOW DOWN
- PIPE BREAK, SINGLE LINE
- PIPE BREAK, DOUBLE LINE
- PIPE CAP-OFF
- HEAT TRACED PIPING
- PUMP
- S — AIR SEPARATOR
- STRAINER C/W SCREWED END
- STRAINER C/W VALVED END
- GATE VALVE
- GLOBE VALVE
- BALL VALVE
- BUTTERFLY VALVE
- DIAPHRAGM VALVE
- PLUG VALVE
- CHECK VALVE
- S — CHECK VALVE C/W SPRING
- THREE-WAY CONTROL VALVE
- FOUR-WAY CONTROL VALVE
- A — ACTUATOR, PNEUMATIC
- M — ACTUATOR, ELECTRIC
- S — ACTUATOR, SOLENOID
- PRESSURE REDUCING VALVE
- PRESSURE REGULATING VALVE
- CALIBRATED BALANCING VALVE
- G — GAS METER
- W — WATER METER
- PRESSURE OR SAFETY RELIEF VALVE
- TEMPERATURE AND PRESSURE RELIEF VALVE

PIPING SYMBOLS

- PIPE EXPANSION JOINT
- PIPE EXPANSION LOOP
- PIPE SLEEVE
- PIPE GUIDE
- PIPE ANCHOR, INTERMEDIATE AND MAIN
- SIGHT GLASS
- FLOW INDICATOR
- FILTER AND STRAINER
- D — UNION, REGULAR / DIELECTRIC
- FLANGED CONNECTION
- AV — AUTOMATIC AIR VENT
- FLOOR DRAIN, OPEN FUNNEL
- STRAP-ON AQUA STAT
- THERMOMETER C/W COCK
- PS — PRESSURE SWITCH
- VENT THRU ROOF C/W CAP
- FS — FLOW SWITCH
- TEMP — TEMPERATURE GAUGE C/W COCK
- PRESS — PRESSURE GAUGE C/W COCK
- THERMOSTATIC EXPANSION VALVE

INSTRUMENT SYMBOLS

- XX / 1 — INSTRUMENT TAG
- M-XXX | XX — PIPE CONTINUATION

PLUMBING SYMBOLS

- BACKFLOW PREVENTER, DOUBLE CHECK VALVE ASSEMBLY
- BACKFLOW PREVENTER, REDUCED PRESSURE
- THERMOSTATIC MIXING VALVE
- WATER HAMMER ARRESTER
- VB — VACUUM BREAKER
- HB — HOSE BIBB
- HOSE REEL
- FLOOR / HUB / FUNNEL / ROOF DRAIN, SQUARE / ROUND
- CO — CLEANOUT
- CO — CLEANOUT UP TO FINISHED FLOOR / GRADE

FIRE SUPPRESSION SYMBOLS

- SPRINKLER HEAD, PENDENT
- SPRINKLER HEAD, SIDEWALL
- SPRINKLER HEAD, UPRIGHT
- SPRINKLER HEAD, UPRIGHT, CONCEALED
- SPRINKLER HEAD, SIDEWALL, CONCEALED
- FIRE DEPARTMENT SIAMESE CONNECTION, TWO-WAY
- PORTABLE FIRE EXTINGUISHER, CARBON DIOXIDE, MULTI-PURPOSE (TYPE BC)
- PORTABLE FIRE EXTINGUISHER, DRY CHEMICAL, MULTI-PURPOSE (TYPE ABC)
- PORTABLE FIRE EXTINGUISHER, COOKING OILS AND FATS (TYPE K)

NEW, EXISTING AND DEMOLISHED CONSTRUCTION

NEW CONSTRUCTION: HWS / HWR

EXISTING CONSTRUCTION: HWS / HWR

DEMOLISHED CONSTRUCTION AREA WITH BOUNDARY:

DEMOLISHED CONSTRUCTION NO BOUNDARY:

PIPE AND EQUIPMENT IDENTIFICATION

300-DCW
- 300 — SIZE (mm)
- DCW — COMMODITY

DWH-1A
- 1 — EQUIPMENT DESIGNATOR NUMBER
- A — DUPLICATION IDENTIFIER (OPTIONAL)
- DWH — EQUIPMENT ABBREVIATION

GENERAL ABBREVIATIONS

A/C	AIR CONDITIONING
AAV	AUTOMATIC AIR VENT
ADJ	ADJUSTABLE
AFF	ABOVE FINISHED FLOOR
AHJ	AUTHORITY HAVING JURISDICTION
BCO	BUILDING CLEANOUT
BDD	BACKDRAFT DAMPER
BFP	BACKFLOW PREVENTER
C/W	COMPLETE WITH
CD	CEILING DIFFUSER
CG	CEILING GRILLE
CNDS	CONDENSATE
CO	CLEANOUT
COND	CONDENSER
DIA	DIAMETER
DPS	DIFFERENTIAL PRESSURE SENSOR
EL	ELEVATION
ESP	EXTERNAL STATIC PRESSURE
FD	FIRE DAMPER
FDC	FIRE DEPARTMENT CONNECTION
FE	FIRE EXTINGUISHER
FE-CO	FIRE EXTINGUISHER, CARBON DIOXIDE
FE-DC	FIRE EXTINGUISHER, DRY CHEMICAL
FEC	FIRE EXTINGUISHER CABINET
FG	FLOOR GRILLE
FHC	FIRE HOSE CABINET
FLR	FLOOR
FSD	FIRE AND SMOKE DAMPER
INV	INVERT
L/s	LITERS PER SECOND
MAX	MAXIMUM
MD	MOTORIZED DAMPER
MIN	MINIMUM
MISC	MISCELLANEOUS
N/A	NOT APPLICABLE
NC	NORMALLY CLOSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OBD	OPPOSED BLADE DAMPER
OD	OUTSIDE DIAMETER
PBD	PARALLEL BLADE DAMPER
PRD	PRESSURE RELIEF DAMPER
PRV	PRESSURE REDUCING VALVE
QTY	QUANTITY
RWL	RAIN WATER LEADER
SD	SMOKE DAMPER
SQ	SQUARE
STD	STANDARD
T&P VALVE	TEMPERATURE AND PRESSURE VALVE
TSTAT	THERMOSTAT
TYP	TYPICAL
U/S	UNDER SIDE
UCD	UNDERCUT DOOR
VAV	VARIABLE AIR VOLUME
VB	VACUUM BREAKER
VD	VOLUME DAMPER, MANUAL
VFD	VARIABLE FREQUENCY DRIVE
W/	WITH
W/O	WITHOUT
WG	WALL GRILLE
WHA	WATER HAMMER ARRESTER

FIXTURE TAG ABBREVIATIONS

CW	CLOTHES WASHER
DF	DRINKING FOUNTAIN
DW	DISHWASHER
ESH	EMERGENCY SHOWER
EWS	EYEWASH STATION
FD	FLOOR DRAIN
GI	GREASE INTERCEPTOR
HB	HOSE BIBB
HR	HOSE REEL
JS	JANITOR SINK
LAV	LAVATORY
LT	LAUNDRY TUB
NFHB	NON-FREEZE HOSE BIBB
RD	ROOF DRAIN
SH	SHOWER
SK	SINK
TMV	THERMOSTATIC MIXING VALVE
UR	URINAL
WC	WATER CLOSET

EQUIPMENT TAG ABBREVIATIONS

AC	AIR COMPRESSOR	FCU	FAN COIL UNIT
ACU	AIR CONDITIONING UNIT	FUR	FURNACE
AF	AIR FILTER	GUH	GAS UNIT HEATER
AHU	AIR HANDLING UNIT	H	INTAKE OR EXHAUST HOOD
AS	AIR SEPARATOR		
B	BOILER	HC	HEATING COIL
BBR	BASEBOARD RADIATOR	HEX	HEAT EXCHANGER
BF	BARE FIN	HG	HUMIDIFIER GRID
CF	CEILING FAN	HP	HEAT PUMP
CH	COMMERCIAL HOOD	HRC	HEAT RECOVERY COIL
CU	CONDENSING UNIT	HRV	HEAT RECOVERY VENTILATOR
CUH	CABINET UNIT HEATER		
CUR	AIR CURTAIN	HUH	HYDRONIC UNIT HEATER
DUC	DUST COLLECTOR	L	INTAKE OR EXHAUST LOUVER
DWH	DOMESTIC WATER HEATER		
E	EXHAUST GRILLE	MAU	MAKE-UP AIR UNIT
EBB	ELECTRIC BASEBOARD HEATER	P	PUMP
		PTAC	PACKAGED TERMINAL AIR CONDITIONER
ECH	ELECTRIC CEILING HEATER	R	RETURN GRILLE
EF	EXHAUST FAN	RP	RADIANT PANEL
EFF	ELECTRIC FORCE FLOW HEATER	RTU	ROOF TOP UNIT
		S	SUPPLY GRILLE OR DIFFUSER
EHC	ELECTRIC HEATING COIL		
ERV	ENERGY RECOVERY VENTILATOR	T	TRANSFER GRILLE
		TB	TERMINAL BOX
EUH	ELECTRIC UNIT HEATER	TK	TANK
EVH	EVAPORATIVE HUMIDIFIER	UH	UNIT HEATER
		WS	WATER SOFTENER
F	FAN		

DUCT COMMODITY ABBREVIATIONS

C/A	COMBUSTION AIR DUCT
E/A	EXHAUST AIR DUCT
FLUE	EXHAUST GAS FLUE
GE/A	GREASE EXHAUST AIR
O/A	OUTDOOR AIR DUCT
R/A	RETURN AIR DUCT
REL/A	RELIEF AIR DUCT
S/A	SUPPLY AIR DUCT
SE	SMOKE EXHAUST DUCT
T/A	TRANSFER AIR DUCT

FIRE SUPPRESSION PIPE COMMODITY ABBREVIATIONS AND LINETYPES

F	FIRE SUPPRESSION
DF	DRY SPRINKLER LINE
WF	WET SPRINKLER LINE

HEATING, VENTILATION AND AIR CONDITIONING PIPE COMMODITY ABBREVIATIONS AND LINETYPES

CHGR	CHILLED GLYCOL RETURN
CHGS	CHILLED GLYCOL SUPPLY
CHWR	CHILLED WATER RETURN
CHWS	CHILLED WATER SUPPLY
CWR	CONDENSER WATER RETURN
CWS	CONDENSER WATER SUPPLY
FOS	FUEL OIL SUPPLY
HGR	HEATING GLYCOL RETURN
HGS	HEATING GLYCOL SUPPLY
HWR	HEATING WATER RETURN
HWS	HEATING WATER SUPPLY
NG	NATURAL GAS
PG	PROPANE GAS
R	REFRIGERANT
ST	STEAM

PLUMBING AND DRAINAGE PIPE COMMODITY ABBREVIATIONS AND LINETYPES

CA	COMPRESSED AIR
CD	CONDENSATE DRAINAGE
DCW	DOMESTIC COLD WATER
DHW	DOMESTIC HOT WATER
DHWR	DOMESTIC HOT WATER RECIRCULATION
DTW	DOMESTIC TEMPERED WATER
SAN	SANITARY DRAIN
SAN	SANITARY DRAIN BELOW FLOOR
STM	STORM DRAIN
STM	STORM DRAIN BELOW FLOOR
V	VENT

GENERAL NOTES:

1. DO NOT SCALE DRAWINGS. THE LOCATION OF ALL ITEMS SHOWN ON THE DRAWINGS OR SPECIFIED THAT ARE NOT DEFINITELY FIXED BY DIMENSIONS ARE APPROXIMATE ONLY. THE EXACT LOCATIONS NECESSARY TO SECURE THE BEST CONDITIONS AND RESULTS MUST BE DETERMINED BY THE SITE CONDITIONS. REVIEW ALL REVISIONS WITH THE CONSULTANT.
2. FLOOR PLANS SHALL BE READ IN CONJUNCTION WITH SCHEMATICS. INFORMATION SHOWN ON FLOOR PLANS SHALL BE ASSUMED TO BE APPLICABLE TO THE RELATED SYSTEM SCHEMATIC AND VICE-VERSA TO PROVIDE A COMPLETE AND OPERATIONAL SYSTEM.
3. VERIFY STRUCTURAL INTEGRITY OF ALL TEMPORARY AND PERMANENT OPENINGS. ADDITIONAL FRAMING TO ENSURE STRUCTURAL INTEGRITY SHALL BE INCLUDED UNDER THIS CONTRACT.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
5. ALL GENERAL NOTES ON THIS SHEET ARE TO BE APPLIED TO ALL DRAWINGS IN THIS SET.

SYMBOLS AND ABBREVIATIONS SHOWN ON THIS SHEET MAY OR MAY NOT BE USED WITHIN THE CONTRACT DRAWINGS

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REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	Y. AN	Y. AN	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

MECHANICAL
LEGEND

DRAWING	REVISION	SHEET
5884-00-M-001	0	6

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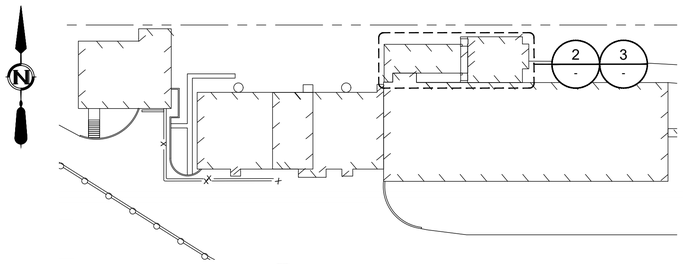
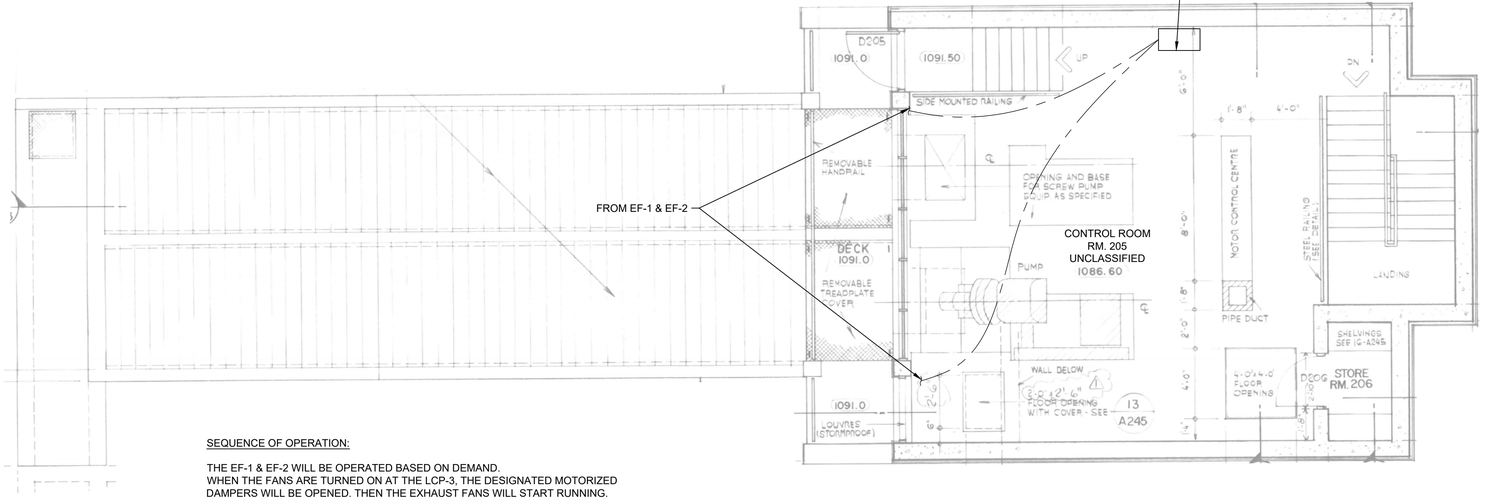
IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



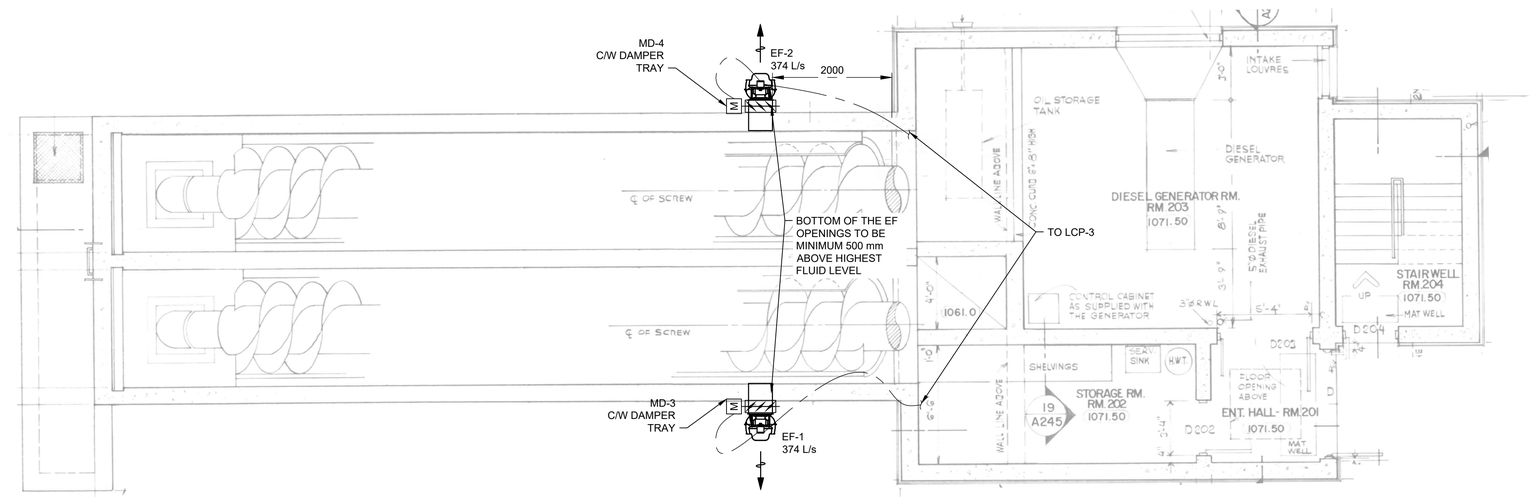
1 - PLAN 1:500
KEY



SEQUENCE OF OPERATION:

THE EF-1 & EF-2 WILL BE OPERATED BASED ON DEMAND.
WHEN THE FANS ARE TURNED ON AT THE LCP-3, THE DESIGNATED MOTORIZED DAMPERS WILL BE OPENED. THEN THE EXHAUST FANS WILL START RUNNING.
AS THE MAINTENANCE OF SCREW PUMP IS COMPLETED AND THE SWITCH IS TURNED OFF AT LCP-3, BOTH FANS WILL RUN 30 MORE MINUTES.

2 - PLAN NTS
UPPER LEVEL



3 - PLAN NTS
LOWER LEVEL

REV	DATE	DESIGN	DRAWN	DESCRIPTION
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CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: NTS

MECHANICAL
EXISTING UPPER AND LOWER LEVEL PLANS
VENTILATION - SCREW PUMP BUILDING 200

DRAWING	REVISION	SHEET
5884-00-M-101	0	7

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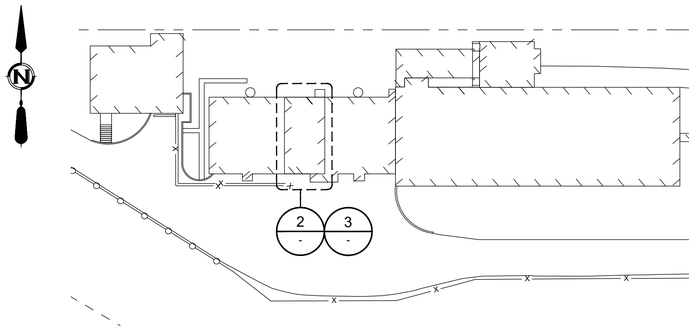
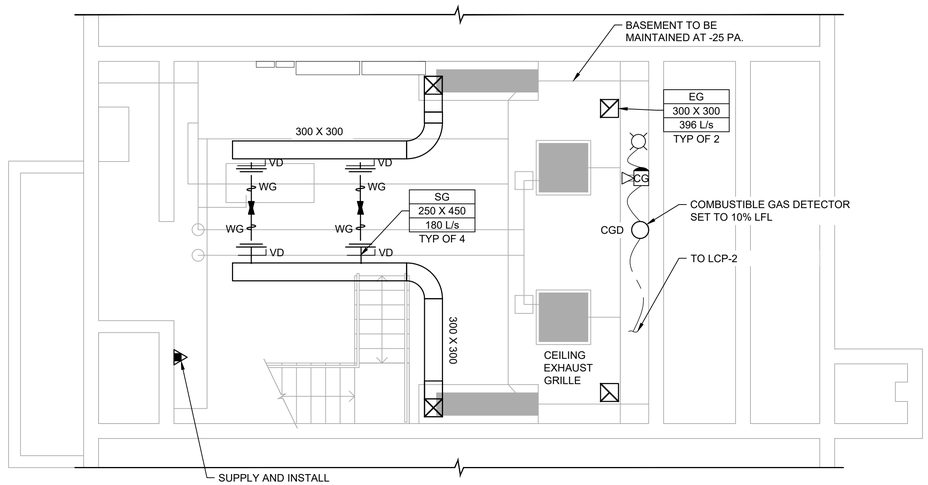


1 - PLAN 1:500
KEY



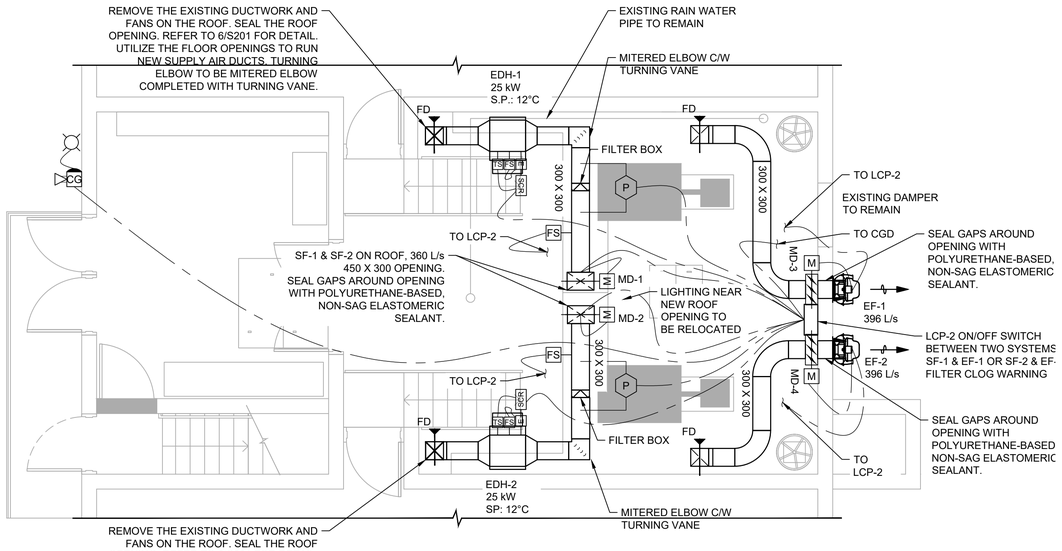
2 - PLAN NTS
BASEMENT LEVEL

SEUENCE OF OPERATION (LCP-2):a

OVER ALL:
1. WHEN COMBUSTIBLE GAS DETECTOR (CGD) IS TRIGGERED, THE HORN AND STROBE LOCATED OUTSIDE OF THE BUILDING AND IN THE BASEMENT SHALL BE TRIGGERED.
2. ONE OF SYSTEM A OR B SHOULD BE RUNNING CONTINUOUSLY.
3. WHEN A SYSTEM FAILS, THE OTHER SYSTEM SHOULD START RUNNING AUTOMATICALLY. AN ALARM SHALL BE SENT TO THE LCP-2 TO NOTE THE SYSTEM FAILURE.
4. A SELECTION SWITCH SHOULD BE INCLUDED ON THE CONTROL PANEL TO ALLOW SWITCH BETWEEN THE TWO SYSTEMS AS THE DUTY SYSTEM.
5. INDICATOR LIGHT TO BE TURNED ON WHEN ONE OF THE FILTER PRESSURE DIFFERENTIAL SENSORS SENSES FILTER CLOG.

SYSTEM A:
1. MD-1 & MD-3 SHALL BE OPENED BEFORE EF-1 & SF-1 ARE TURNED ON.
2. SF-1 & EF-1 SHALL BE TURNED ON AT THE SAME TIME.
3. EDH-1 TO RUN AUTOMATICALLY AS NEEDED WHEN SF-1 IS TURNED ON.

SYSTEM B:
1. MD-2 & MD-4 SHALL BE OPENED BEFORE EF-2 & SF-2 ARE TURNED ON.
2. SF-2 & EF-2 SHALL BE TURNED ON AT THE SAME TIME.
3. EDH-2 TO RUN AUTOMATICALLY AS NEEDED WHEN SF-2 IS TURNED ON.



3 - PLAN NTS
GROUND FLOOR

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CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

MECHANICAL
EXISTING BASEMENT AND GROUND FLOOR PLANS
VENTILATION - DIGESTER CONTROL BUILDING 400

DRAWING	REVISION	SHEET
5884-00-M-102	0	8

IF NOT 59 mm ADJUST SCALES 25 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS. TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

CABLE, CONDUIT AND WIRE

- CONDUIT RUN ON SURFACE (WALL OR CEILING)
- CONDUIT RUN IN SLAB (OR BELOW GRADE)
- CONDUIT CAPPED
- CONDUIT GOING UP
- CONDUIT GOING DOWN
- FLEXIBLE CONDUIT
- CONDUIT HOME RUN c/w NUMBER OF WIRES
- CONDUIT EXPANSION JOINT
- CONDUIT BEND
- BARE GROUND WIRE
- OVERHEAD POWER SERVICE ENTRANCE
- OVERHEAD TELEPHONE SERVICE ENTRANCE
- JUNCTION BOX - CEILING SPACE
- JUNCTION BOX - FLUSH MOUNTED
- JUNCTION BOX - WALL MOUNTED
- JUNCTION BOX - UNDERGROUND
- JUNCTION BOX - MOTOR / EQUIPMENT
- MULTI-CABLE TRANSIT (MCT)
- SPARE WIRE LOOP
- CABLE OR CONDUIT DESIGNATION (PC-101)
  - PC - POWER
  - TC - TELEPHONE
  - CC - CONTROL
  - IC - INSTRUMENTATION
  - HC - HEATING
- A10-b — PANEL "A", CIRCUIT "10", SWITCH "b"

POWER

- XFMR — POWER TRANSFORMER
- PNL "A" — MAIN DISTRIBUTION PANEL "A"
- SPLTR — SPLITTER
- MUA2D 5005 — MOTOR AND/OR EQUIPMENT TAG c/w NAME, PLANT AREA AND NUMBER
- M — MOTOR
- D — MOTORIZED DAMPER
- MOV — MOTOR OPERATED VALVE
- SOV — SOLENOID OPERATED VALVE
- ELECTRIC HEATER
- SINGLE RECEPTACLE
- DUPLEX RECEPTACLE
- DUPLEX RECEPTACLE - WEATHERPROOF (WP)
- SPLIT DUPLEX RECEPTACLE
- ISOLATED GROUND RECEPTACLE
- GROUND FAULT (GFCI) RECEPTACLE
- ABOVE COUNTER DUPLEX RECEPTACLE
- ABOVE COUNTER SPLIT DUPLEX RECEPTACLE
- ABOVE COUNTER GROUND FAULT (GFCI) RECEPTACLE
- FLOOR MOUNTED SINGLE RECEPTACLE
- FLOOR MOUNTED DUPLEX RECEPTACLE
- SPECIAL SINGLE PHASE RECEPTACLE
- SPECIAL THREE PHASE RECEPTACLE
- OVERHEAD REEL DUPLEX RECEPTACLE
- SINGLE PHASE POWER CONNECTION
- THREE PHASE POWER CONNECTION
- W — WELDING RECEPTACLE

GENERAL

- KN — KEYNOTE
- DEMOLITION SCOPE

LIGHTING

- A — LUMINAIRE TYPE "A"
- SURFACE MOUNTED OR SUSPENDED LUMINAIRE
- RECESSED LUMINAIRE

NOTE:
SYMBOLS AND ABBREVIATIONS SHOWN ON LEGENDS AND THIS SHEET MAY/MAY NOT BE USED WITHIN THE CONTRACT DRAWINGS.

LAYOUT SYMBOLS

- SURFACE MOUNTED OR SUSPENDED 610 x 610 LUMINAIRE
- RECESSED 610 x 610 LUMINAIRE
- STRIP LUMINAIRE
- WALL MOUNTED LUMINAIRE
- SURFACE MOUNTED OR SUSPENDED UNSWITCHED LUMINAIRE
- RECESSED UNSWITCHED LUMINAIRE
- AREA LIGHTING LUMINAIRE
- SURFACE MOUNTED OR SUSPENDED LUMINAIRE
- LUMINAIRE ON EMERGENCY POWER
- RECESSED LUMINAIRE
- RECESSED LUMINAIRE ON EMERGENCY POWER
- WALL MOUNTED LUMINAIRE
- POLE MOUNTED LUMINAIRE
- CEILING MOUNTED EXIT SIGN c/w OPTIONAL DIRECTIONAL ARROW
- WALL MOUNTED EXIT SIGN c/w OPTIONAL DIRECTIONAL ARROW
- TENON MOUNTED LUMINAIRE
- EMERGENCY LIGHTING UNIT c/w BATTERY PACK, CHARGER AND TWO HEADS
- WALL MOUNTED SINGLE EMERGENCY LIGHTING HEAD c/w JUNCTION BOX
- WALL MOUNTED DOUBLE EMERGENCY LIGHTING HEAD c/w JUNCTION BOX
- B — 1 LAMP BALLAST (REMOTE MOUNTED)
- 2 LAMP BALLAST (REMOTE MOUNTED)

FIRE ALARM

- FIRE ALARM PANEL AND / OR ANNUNCIATOR
- F or PS — BREAK GLASS STATION
- F — FIRE ALARM BELL
- F cd — FIRE ALARM HORN AND STROBE c/w CANDELA LEVEL
- F — FIRE ALARM PHONE
- F — FIRE ALARM SPEAKER
- SMOKE DETECTOR
- SMOKE DETECTOR - DUCT MOUNTED
- COMBINATION HEAT DETECTOR
- HEAT DETECTOR - FIXED TEMPERATURE
- HEAT DETECTOR - RATE-OF-RISE
- F cd — FIRE ALARM STROBE LIGHT c/w CANDELA LEVEL
- END-OF-LINE RESISTOR
- FS — FLOW SWITCH
- PS — PRESSURE SWITCH
- Z — TAMPER SWITCH
- G — GAS DETECTOR
- IN — INFRARED DETECTOR
- U — ULTRAVIOLET DETECTOR
- D — MAGNETIC DOOR RELEASE
- L — ELECTRIC DOOR LOCK
- F — PRE-SIGNAL BUZZER
- CR — CONTROL RELAY MODULE
- I — ISOLATOR BASE MODULE
- ARM — ADDRESSABLE ALARM RELAY MODULE

ABBREVIATIONS

BD	- BUS DUCT
CB	- CIRCUIT BREAKER
DB	- DUCT BANK
DS	- DISCONNECT SWITCH
MCC	- MOTOR CONTROL CENTRE
PDP	- POWER DISTRIBUTION PANEL
PNL	- BRANCH PANEL BOARD
SWB	- SWITCHBOARD
T or XFMR	- TRANSFORMER
UPS	- UNINTERRUPTIBLE POWER SUPPLY

COMMUNICATIONS

- TTB — TELEPHONE TERMINAL BOARD
- TELEPHONE / DATA OUTLET - SIMPLEX
- TELEPHONE/DATA OUTLET: DUPLEX
- 19" 2-POST RACK
- 19" 4-POST RACK
- 19" WALL MOUNTED RACK
- XX — ANTENNA
- WiFi — WIFI CONNECTION POINT
- S — SPEAKER - CEILING MOUNTED
- S — SPEAKER - WALL MOUNTED

GROUNDING

- GROUND BUS
- GROUND COMPRESSION CONNECTION
- EQUIPMENT GROUND CONNECTION
- THERMIT WELD GROUND CONNECTION
- GROUND ROD
- GROUND WELL AND ROD
- GROUND GRID w/ WELLS AND RODS

SECURITY

- CARD READER
- SINGLE DOOR ALARM CONTACT
- DOUBLE DOOR ALARM CONTACT
- C P — SECURITY CAMERA - CEILING MOUNTED
- C — DOME SECURITY CAMERA - CEILING MOUNTED
- C — DOME SECURITY CAMERA - WALL MOUNTED
- XXX — MOTION DETECTOR
  - REX - REQUEST TO EXIT
  - LGT - LIGHTING CONTROL
  - SEC - SECURITY SENSOR
  - CAM - CAMERA ACTIVATION

CONTROL

- Ax a — SINGLE POLE SWITCH (SWITCH "a") PANEL "A" CIRCUIT "x"
- 2 SWITCHES IN 2 GANG BOX
- 3 SWITCHES IN 3 GANG BOX
- 4 SWITCHES IN 4 GANG BOX
- (2) — TWO POLE SWITCH
- (3) — THREE WAY SWITCH
- (4) — FOUR WAY SWITCH
- X — SWITCH c/w PILOT LIGHT
- M — MANUAL MOTOR SWITCH
- M — MANUAL MOTOR SWITCH c/w PILOT LIGHT
- K — KEY OPERATED SWITCH
- EP — EXPLOSION PROOF SWITCH
- WP — WEATHERPROOF SWITCH
- e — LOW VOLTAGE SWITCH (CIRCUIT "a")
- K, P — LOW VOLTAGE SWITCH (K-KEY OPERATED, P-PILOT LIGHT)
- DIMMER SWITCH
- SPECIAL LOW VOLTAGE SWITCH UNIT (SEE SPECIFICATIONS)
- RC — LOW VOLTAGE SWITCHING RELAY CABINET
- M — MOTION SENSOR SWITCH
- P — PHOTOELECTRIC CELL
- DISCONNECT SWITCH - FUSED
- DISCONNECT SWITCH - UNFUSED
- MANUAL MOTOR STARTER
- MAGNETIC MOTOR STARTER
- COMBINATION MAGNETIC STARTER
- T — LOW VOLTAGE THERMOSTAT
- T — LINE VOLTAGE THERMOSTAT
- H — HUMIDSTAT
- OI O I — ON-OFF CONTROL STATION
- HOA H O A — HAND-OFF-AUTO SELECTOR SWITCH
- LO L O — LOCKOUT STOP CONTROL STATION
- LOR L O R — LOCAL-OFF-REMOTE CONTROL STATION
- SELECTOR SWITCH (HOA, LOR, LO or OA)
- START-STOP PUSHBUTTON AND SELECTOR SWITCH (HOA, LOR, LO or OA)
- LOS — LOCKOUT STOP PUSHBUTTON
- START-STOP PUSHBUTTON
- ESD — EMERGENCY SHUTDOWN PUSHBUTTON
- THERMISTOR CONTROL TRIPPING UNIT
- TS — TIME SWITCH
- LVT XX — LOW VOLTAGE TRANSFORMER (XX = TRANSFORMER NUMBER)

SINGLE LINE DIAGRAM / SCHEMATIC SYMBOLS

- EQUIPMENT BUS
- BUS EXTENSION / CONNECTION
- 52 — 4160 V, 1200 A, 150 MVA — POWER CIRCUIT BREAKER
- 52 — 4160 V, 1200 A, 150 MVA — DRAWOUT POWER CIRCUIT BREAKER
- AS — AMMETER SWITCH
- VS — VOLTMETER
- XXX:X — CURRENT TRANSFORMER c/w RATIO AND QUANTITY
- XXX:X QTY — ZERO SEQUENCING CURRENT TRANSFORMER c/w RATIO AND QUANTITY
- V-V QTY — POTENTIAL TRANSFORMER c/w VOLTAGE RATING AND QUANTITY
- K — KEY OPERATED INTERLOCK
- M — MOTOR OPERATED SWITCH
- DMS — DIGITAL METERING SYSTEM
- M — UTILITY POWER METER
- SURGE ARRESTER
- SURGE ARRESTER AND SURGE CAPACITOR
- V-V A — DRAWOUT FUSED POTENTIAL TRANSFORMER
- DELTA-DELTA TRANSFORMER
- DELTA-WYE GROUND TRANSFORMER
- DELTA-WYE RESISTOR GROUND TRANSFORMER
- CLOSED DELTA
- THREE PHASE WYE
- THREE PHASE WYE TO GROUND
- THREE PHASE ZIGZAG TO GROUND
- THREE PHASE WYE w/ RESISTOR TO GROUND
- MALE AND FEMALE DISCONNECT DEVICE
- 100AT 225AF, 3P — CIRCUIT BREAKER
- 100AT 225AF, 3P — DRAWOUT CIRCUIT BREAKER
- NON-FUSED DISCONNECT SWITCH
- FUSED DISCONNECT SWITCH
- FUSED HRC DISCONNECT SWITCH
- LOAD BREAK DISCONNECT SWITCH
- FUSED LOAD BREAK DISCONNECT SWITCH
- HORN GAP SWITCH
- INTERRUPTER SWITCH
- FUSED INTERRUPTER SWITCH
- GROUND SWITCH
- kVAR — CAPACITOR FOR PF CORRECTION c/w kVAR RATING
- NORMALLY OPEN CONTACT
- NORMALLY CLOSED CONTACT
- PLC — PROGRAMMABLE LOGIC CONTROLLER
- REACTOR
- HARMONIC FILTER
- or — TRANSFER SWITCH (A = AUTO, M = MANUAL)
- FLEX CONNECTOR
- J — JUNCTION BOX MOUNTED NEAR MOTOR
- RTD — RESISTANCE TEMPERATURE DETECTOR
- 1 — FVNR MAGNETIC STARTER c/w SIZE
- 1 1 — FVR (REVERSING) STARTER c/w SIZE
- 1 1 — TWO SPEED STARTER c/w SIZE
- THERMAL OVERLOAD RELAY
- X:X X — ELECTRONIC OVERLOAD c/w RATIO AND QUANTITY
- HZ — VARIABLE SPEED DRIVE
- S/S — SOFT START REDUCED VOLTAGE
- GENERATOR
- - HP — SQUIRREL CAGE MOTOR
- - HP — MOTORIZED VALVE
- LIGHTING OR POWER PANEL
- PANEL 'A'
- SPECIAL SINGLE PHASE RECEPTACLE
- SPECIAL THREE PHASE RECEPTACLE
- W — WELDING RECEPTACLE
- xxW — MOTOR SPACE HEATER
- SOLID STATE SURGE PROTECTIVE DEVICE
- SPD — SURGE PROTECTIVE DEVICE
- TS — TEST SWITCH (FT-1)
- SB — SHORTING TERMINAL BLOCK
- GROUND TO EARTH
- BATTERY
- 50 QTY — PROTECTIVE RELAY c/w QUANTITY (1 LINE)
- 50/51 QTY — PROTECTIVE RELAY c/w QUANTITY (2 LINE)
- RELAY SHUNT
- H1 H2 XXX XXX X1 X2 — CONTROL POWER TRANSFORMER
- X HP — SINGLE or THREE PHASE MOTOR
- X — RELAY COIL
- TD — TD_ 0-30 SECS — TIMING RELAY COIL w/ TDE - TIME DELAY ENERGIZED, TDD - TIME DELAY DE-ENERGIZED AND TIME RANGE

COIL ABBREVIATIONS

CR	- CONTROL RELAY
RA	- AUXILIARY RELAY
PFR	- POWER-FAIL RELAY
OTR	- OVERLOAD-TRIP RELAY
CC	- CLOSING COIL
HC	- HOLDING COIL
LC	- LIGHTING CONTACT COIL
M	- MOTOR STARTER COIL

- A — INDICATING PILOT LIGHT c/w LENS COLOUR R = RED, G = GREEN, A = AMBER, Y = YELLOW, W = WHITE
- ETM — ELAPSED TIME METER
- O/L — MOTOR OVERLOAD CONTACT
- x A — FUSE c/w FUSE No. or AMP RATING
- CONDUIT SEAL WP-WEATHERPROOF, EP-EXPLOSION PROOF
- X OHMS — RESISTOR c/w RESISTANCE RATING
- SERIES COIL OR SOLENOID VALVE
- SURGE SUPPRESSOR
- SUPPRESSOR M — MOTOR SURGE SUPPRESSOR
- G — INDICATING LIGHT PUSH TO TEST c/w COLOR TYPE
- SEMICONDUCTOR DIODE
- 113 — WIRE WITH WIRE NUMBERS
- MECHANICAL CONNECTION
- WIRES CROSSOVER
- WIRES CONNECTED
- FIELD CONNECTION
- NORMALLY CLOSED MUSHROOM HEAD PUSHBUTTON - MOMENTARY
- NORMALLY OPEN PUSHBUTTON - MOMENTARY
- NORMALLY CLOSED PUSHBUTTON - MOMENTARY
- THREE POLE CIRCUIT BREAKER (CONTROL SCHEMATIC ONLY)
- THREE POLE DISCONNECT SWITCH (CONTROL SCHEMATIC ONLY)
- SINGLE POLE SINGLE THROW DISCONNECT SWITCH
- SINGLE POLE DOUBLE THROW DISCONNECT SWITCH
- ON OFF — TWO (2) POSITION SELECTOR SWITCH (ON-OFF SWITCH SHOWN IN ON POSITION)
- H A O — THREE (3) POSITION SELECTOR SWITCH (HAND-OFF-AUTO SHOWN IN HAND POSITION)
- C 1 2 3 — DUAL TRANSFER SWITCH
- FLOW SWITCH NORMALLY OPEN OR CLOSED
- LEVEL SWITCH NORMALLY OPEN OR CLOSED
- LIMIT SWITCH NORMALLY OPEN OR CLOSED
- PRESSURE SWITCH NORMALLY OPEN OR CLOSED
- TEMPERATURE SWITCH NORMALLY OPEN OR CLOSED
- TERMINALS - TYPE AND LOCATION ASSIGNMENT DESIGNATED BY PROJECT DESIGN

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Lake of the Woods KENORA

CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

ELECTRICAL
LEGEND

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5884-00-E-001	0	9

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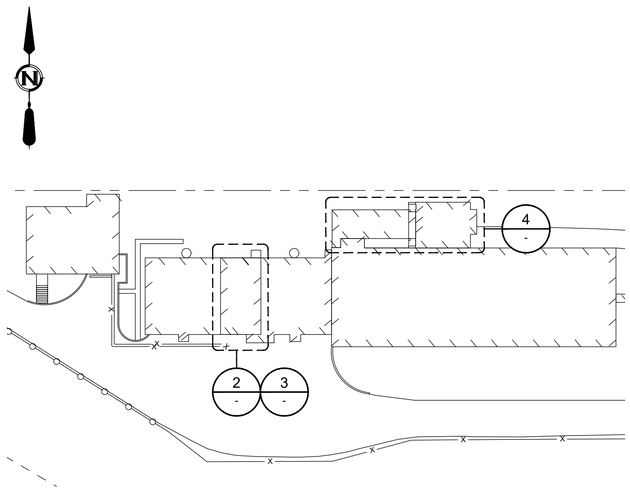
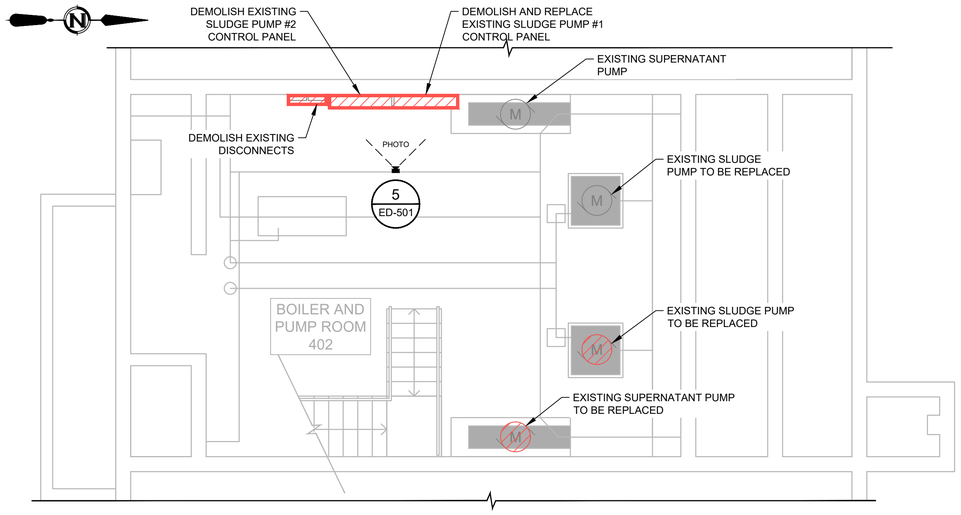
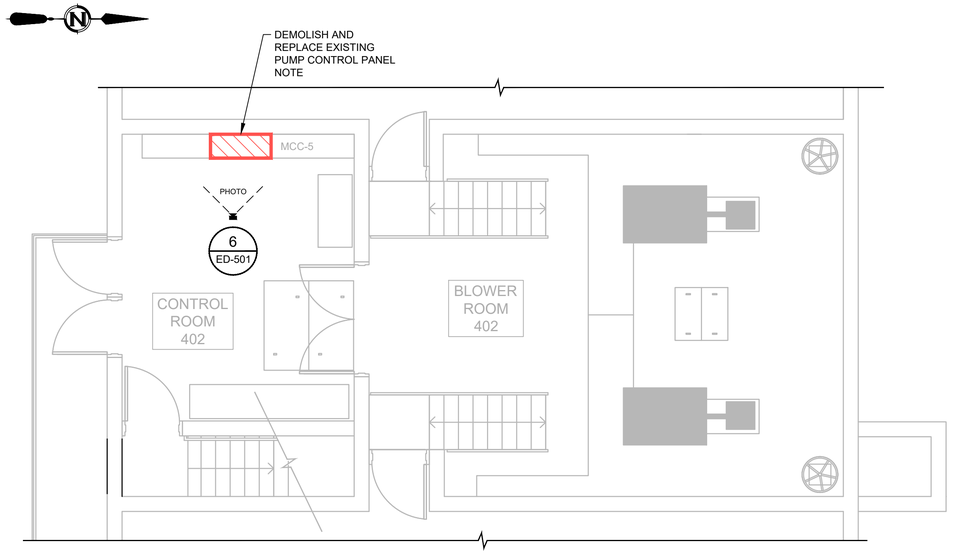


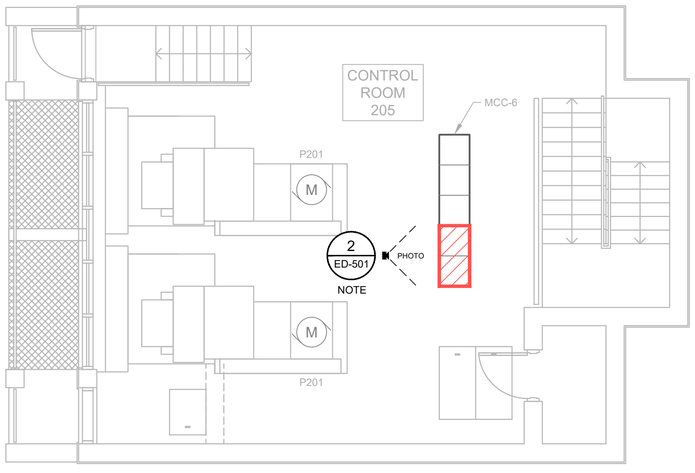
1 / - PLAN 1:500
KEY



2 / ED-101 PLAN 1:50
EXISTING BASEMENT - DIGESTER CONTROL BUILDING 400



3 / ED-101 PLAN 1:50
EXISTING MAIN FLOOR - DIGESTER CONTROL BUILDING 400



4 / ED-101 PLAN 1:50
EXISTING UPPER FLOOR - SCREW PUMP BUILDING 200

NOTE:
EXISTING MCC BUCKETS TO REMAIN. ALL CONTENTS WITHIN THE EXISTING BUCKET SHALL BE REMOVED.

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100169270
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ELECTRICAL UPGRADES
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EXISTING FLOOR PLANS - DEMOLITION
SCREW PUMP BUILDING AND DIGESTER BUILDING

DRAWING	REVISION	SHEET
5884-00-ED-101	0	10

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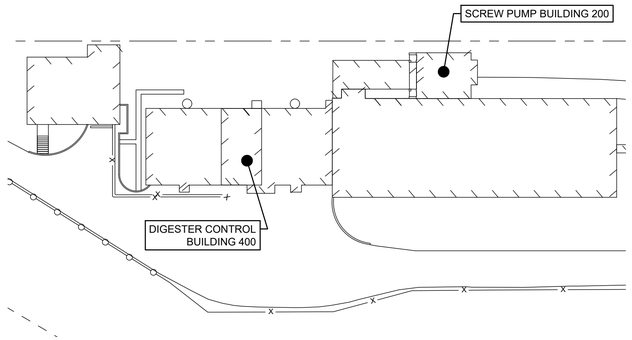
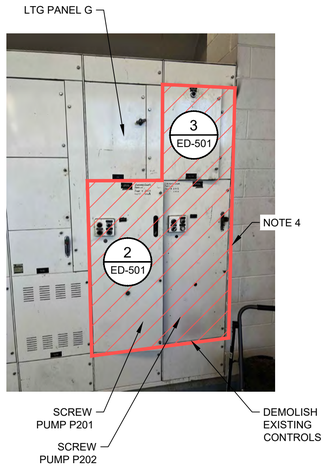
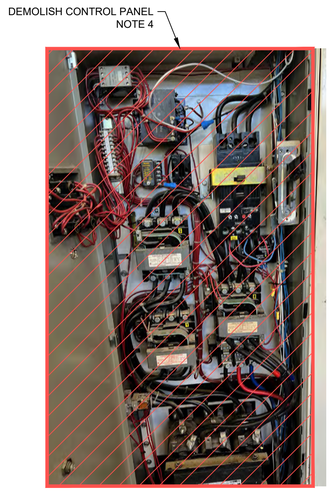


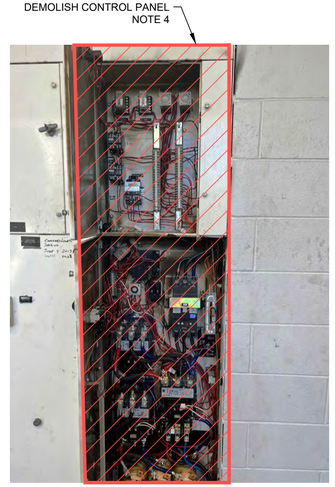
1 ED-501 **PLAN** 1:500
KEY



2 ED-101 **PHOTO** NTS
EXISTING CONTROL PANELS IN MCC-6 SCREW PUMP BUILDING 200



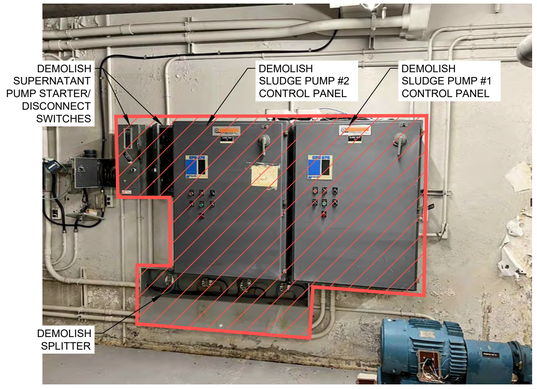
3 ED-101 **PHOTO** NTS
EXISTING SCREW PUMP CONTROL PANEL SCREW PUMP BUILDING 200



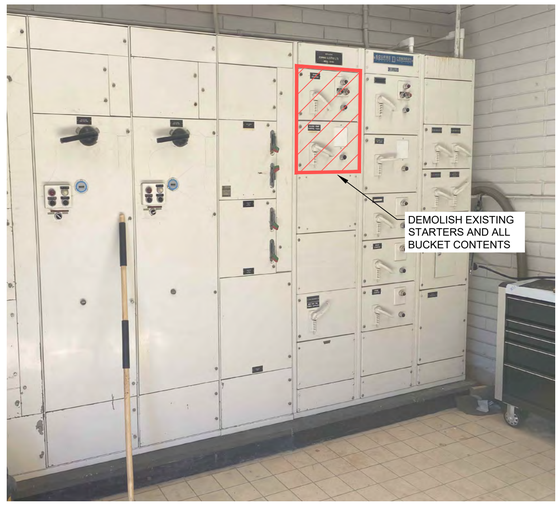
4 ED-101 **PHOTO** NTS
EXISTING SCREW PUMP CONTROL PANEL SCREW PUMP BUILDING 200

NOTES:

1. CONTRACTOR TO FIELD VERIFY ALL SPARE BUCKETS IN MCC, TYPICAL.
2. ALL U/G CONDUITS RELATING TO THE SCOPE OF WORK SHALL BE CUT AND CAPPED.
3. ALL EXISTING CONDUIT AND WIRING BETWEEN MCC-5, SPLITTER, SUPERNATANT AND SLUDGE PUMPS AND ASSOCIATED EQUIPMENT TO BE REMOVED AND REPLACED WITH NEW.
4. EXISTING MCC BUCKETS TO REMAIN. ALL CONTENTS WITHIN THE EXISTING BUCKET SHALL BE REMOVED.
5. REPLACE BOTH EXISTING TEMPERATURE TRANSMITTERS WITH SAME MODEL NUMBER.



5 ED-101 **PHOTO** NTS
EXISTING SLUDGE PUMPS CONTROL PANELS DIGESTER BUILDING 400



6 ED-101 **PHOTO** NTS
EXISTING MCC-5 DIGESTER CONTROL BUILDING 400

. ED-101 **PHOTO** NTS
TEMPERATURE PROBE A DIGESTER CONTROL BUILDING 400

8 ED-101 **PHOTO** NTS
TEMPERATURE PROBE B DIGESTER CONTROL BUILDING 400

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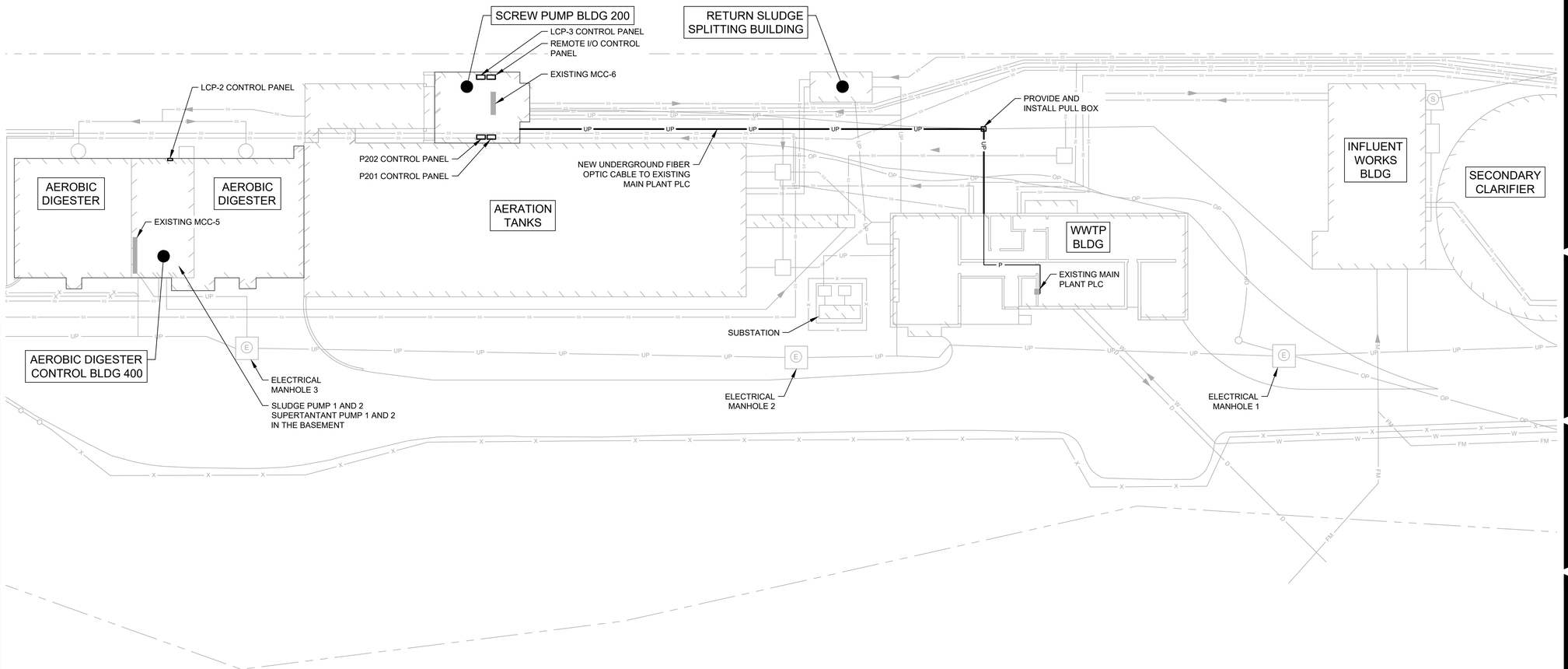
EXISTING PHOTOS - DEMOLITION
SCREW PUMP BUILDING AND DIGESTER BUILDING

DRAWING	REVISION	SHEET
5884-00-ED-501	0	11



1 E-101 PLAN 1:250

EXISTING WWTP SITE - POWER

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ELECTRICAL
EXISTING SITE PLAN
POWER

DRAWING	REVISION	SHEET
5884-00-E-101	0	12

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50 mm

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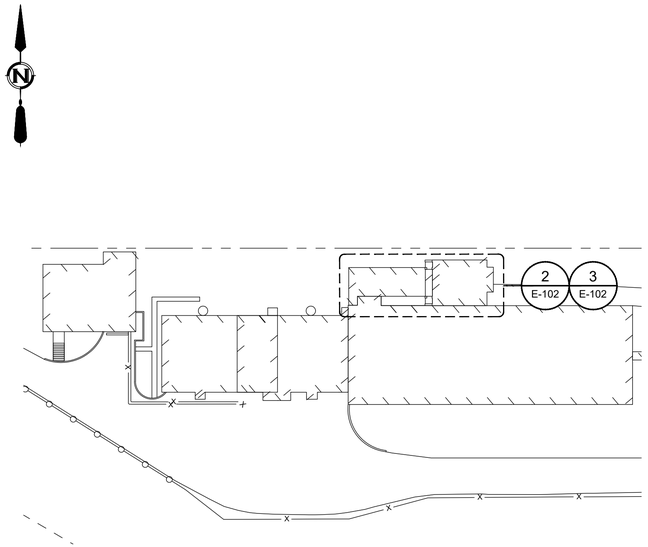
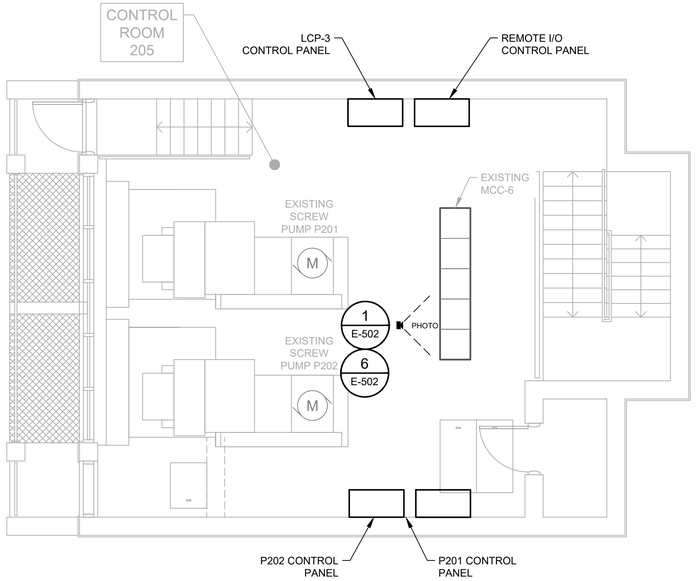
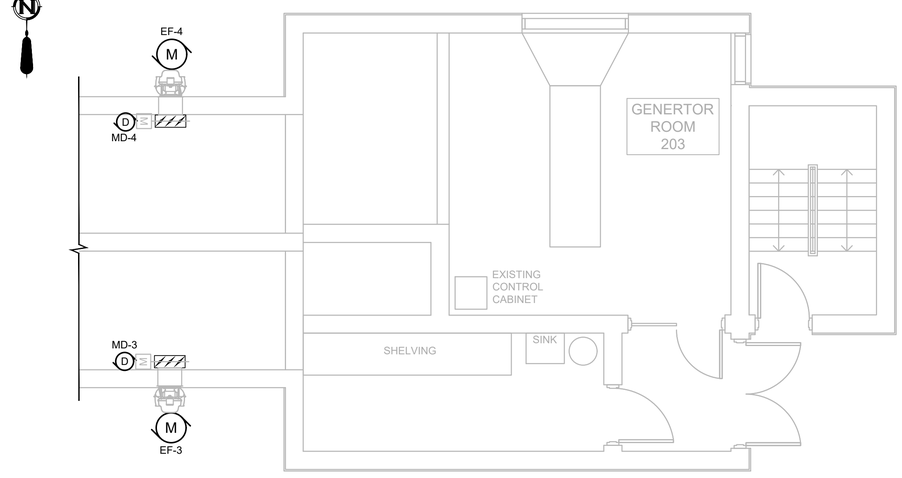


1 E-102 PLAN 1:500
KEY



2 E-102 PLAN 1:50
EXISTING UPPER LEVEL - POWER



3 E-102 PLAN 1:50
EXISTING LOWER LEVEL - POWER

LEGEND:
NEW
EXISTING

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ELECTRICAL
EXISTING UPPER AND LOWER LEVEL PLANS
POWER - SCREW PUMP BUILDING 200

DRAWING	REVISION	SHEET
5884-00-E-102	0	13

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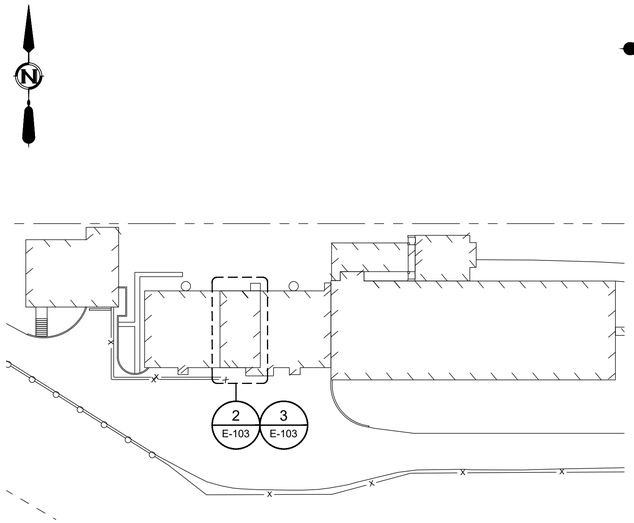
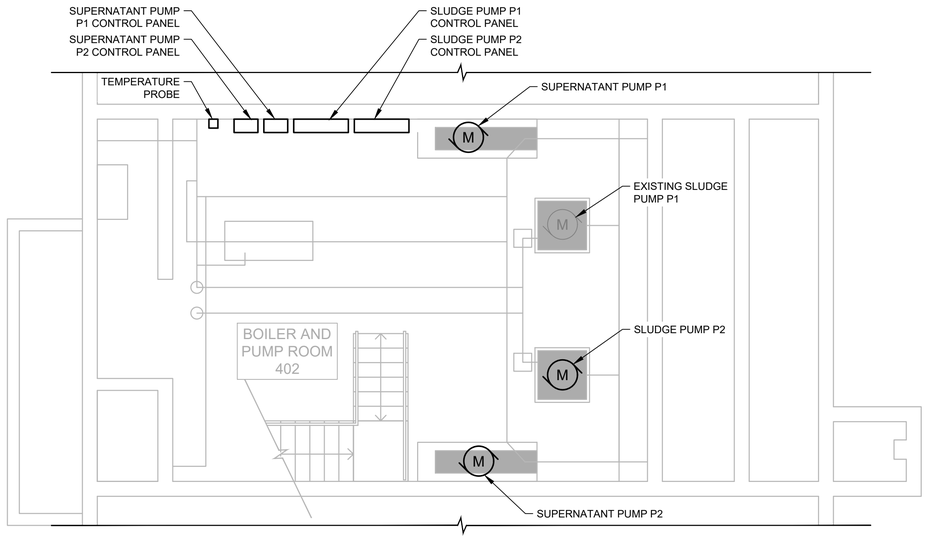
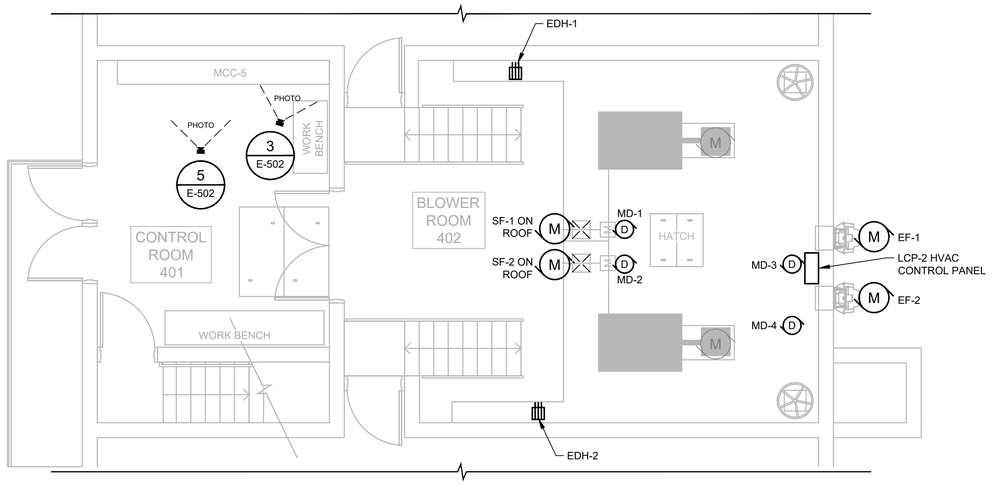


1 E-103 PLAN 1:500
KEY



2 E-103 PLAN 1:50
EXISTING BASEMENT FLOOR - POWER



3 E-103 PLAN 1:50
EXISTING MAIN FLOOR - POWER

LEGEND:
NEW
EXISTING

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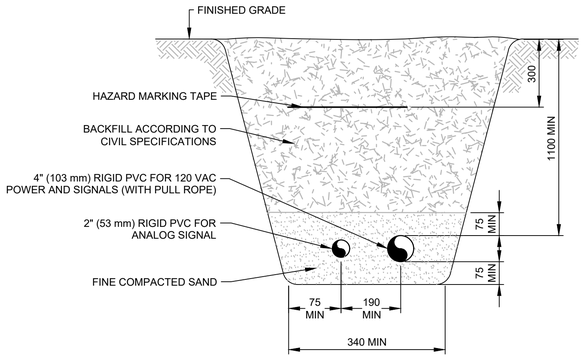
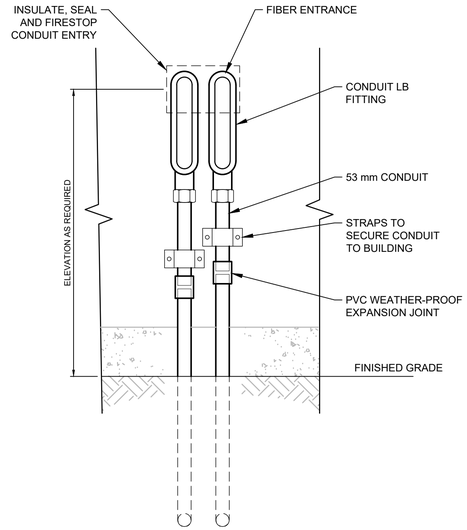
ELECTRICAL
EXISTING BASEMENT AND MAIN FLOOR PLAN
POWER - DIGESTER CONTROL BULDING 400

DRAWING	REVISION	SHEET
5884-00-E-103	0	14

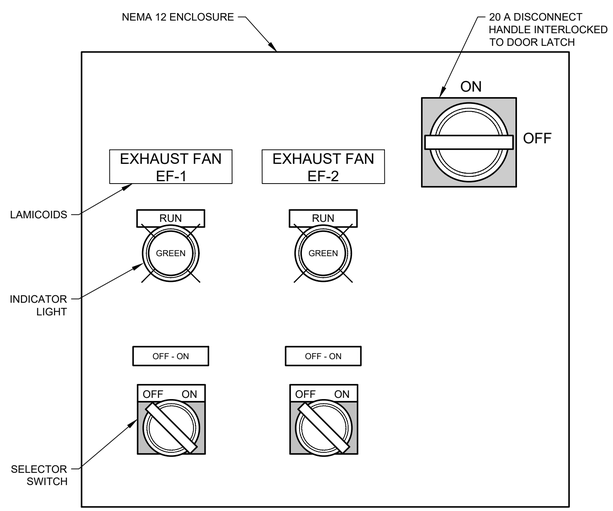


NOTE:
CONDUIT TO BE RIGID PVC, TO CSA STANDARD C22.2#211.2.
FINAL LENGTH AND DIRECTION TO BE DETERMINED ON SITE.

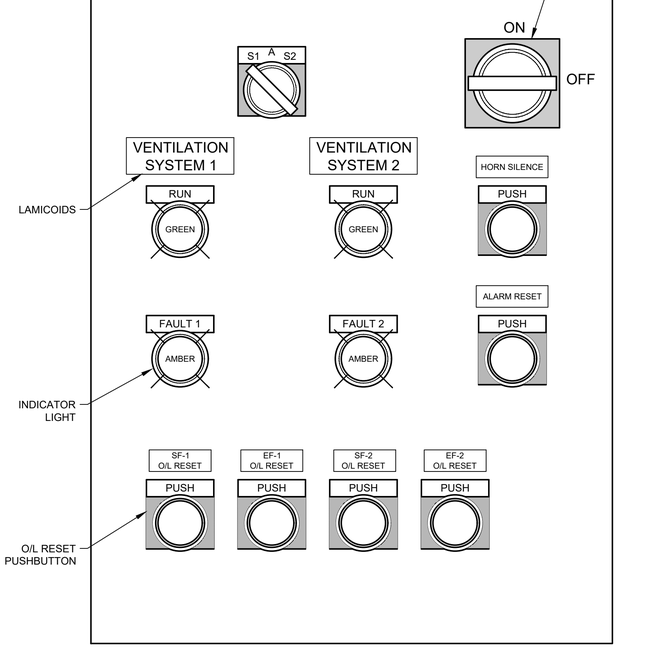
1 **TYPICAL DETAIL** NTS
UNDERGROUND SERVICE



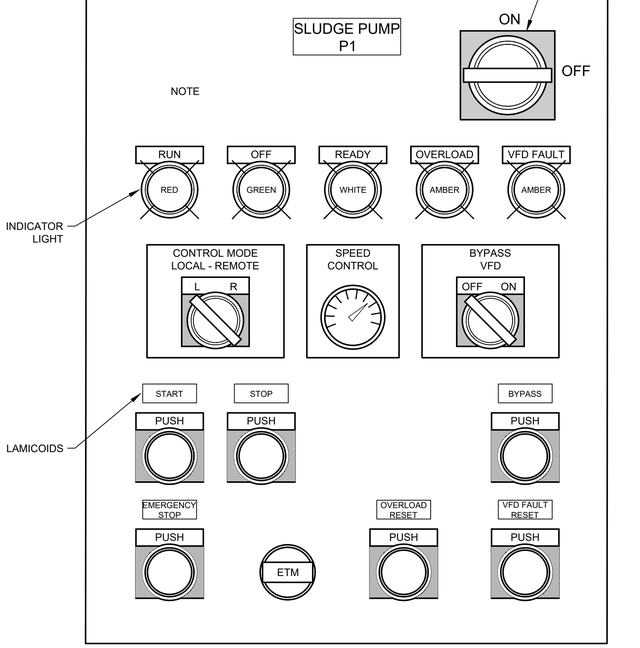
2 **TYPICAL DETAIL** NTS
CONDUIT WALL PENETRATION



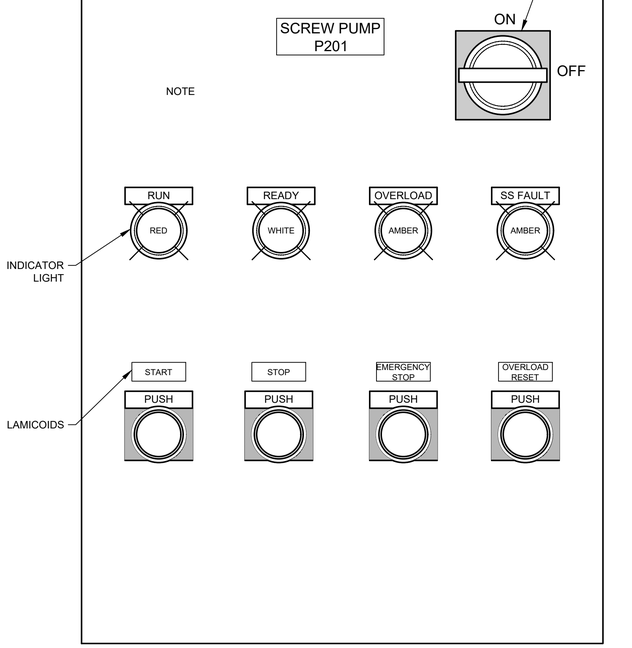
3 E-601 **DETAIL** NTS
EXHAUST FAN EF-1 AND EF-2
CONTROL PANEL
SCREW PUMP BUILDING 200



4 E-601 **DETAIL** NTS
VENTILATION CONTROL PANEL
SCREW PUMP BUILDING 200 &
DIGESTER CONTROL BUILDING 400



5 E-601 **DETAIL** NTS
VFD STARTER CONTROL PANEL
DIGESTER CONTROL BUILDING 400
TYPICAL FOR SLUDGE PUMP P1 AND P2



6 E-601 **DETAIL** NTS
SOFT STARTER CONTROL PANEL, SCREW PUMP BUILDING 200, TYPICAL FOR SCREW PUMP P201 AND P202, AND FOR SUPERNATANT PUMP P1 AND P2

NOTE:
VENTILATION FAN REQUIRED FOR STARTER PANELS. FAN SHALL RUN ABOBE 25°C.

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DETAILS

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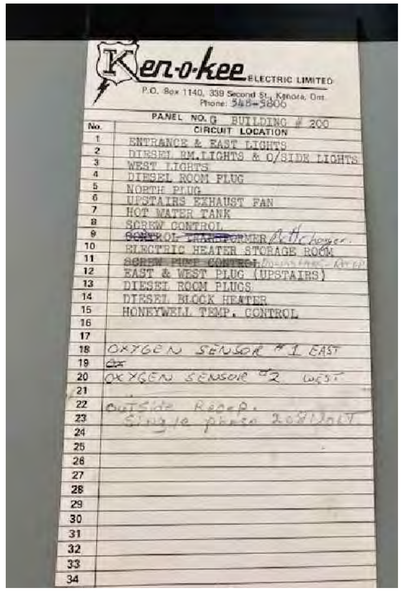
5884-00-E-501	0	15

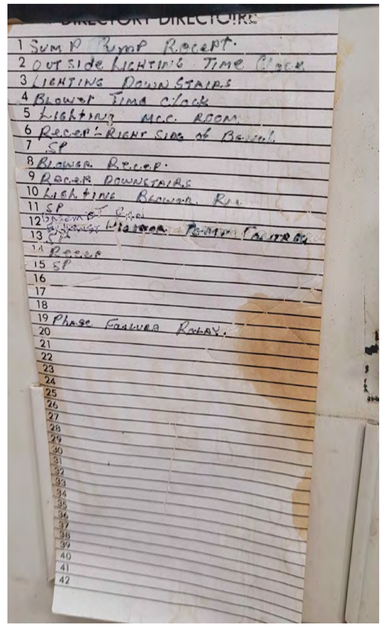
1 / E-102 PHOTO NTS
SCREW PUMP BUILDING 200
LIGHTING PANEL G



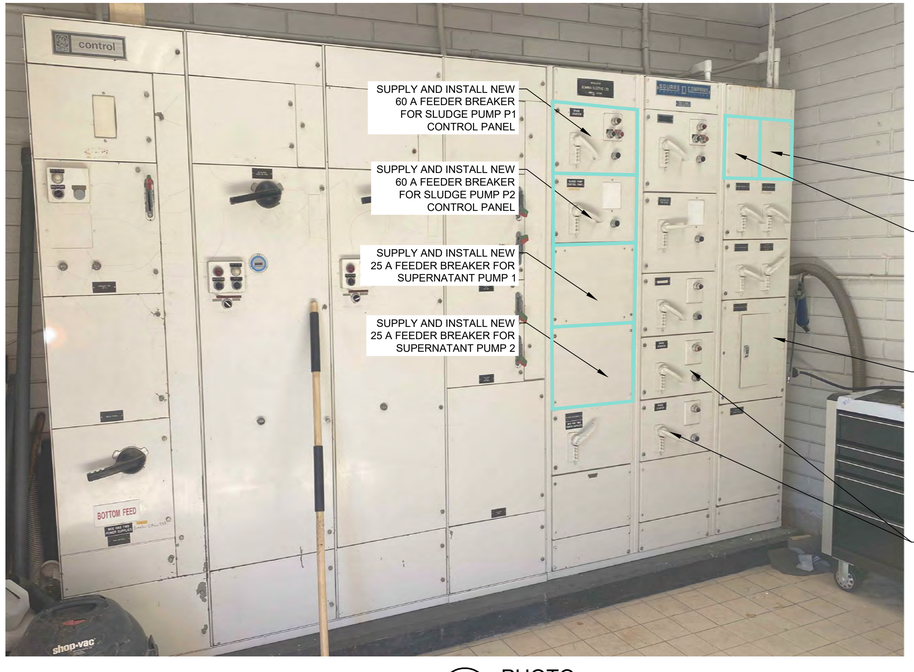
2 / E-102 PHOTO NTS
SCREW PUMP BUILDING 200
LIGHTING PANEL G

3 / E-103 PHOTO NTS
DIGESTER BUILDING 400
LIGHTING PANEL D

NOTE:
CONTRACTOR TO FIELD VERIFY ALL SPARE BUCKETS IN MCC, TYPICAL.



4 / E-103 PHOTO NTS
DIGESTER BUILDING 400
LIGHTING PANEL D



5 / E-103 PHOTO NTS
DIGESTER BUILDING 400
MCC-5

1 / E-502 LIGHTING PANEL G

6 / E-103 PHOTO NTS
SCREW PUMPS BUILDING 200
MCC-6

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ELECTRICAL UPGRADES
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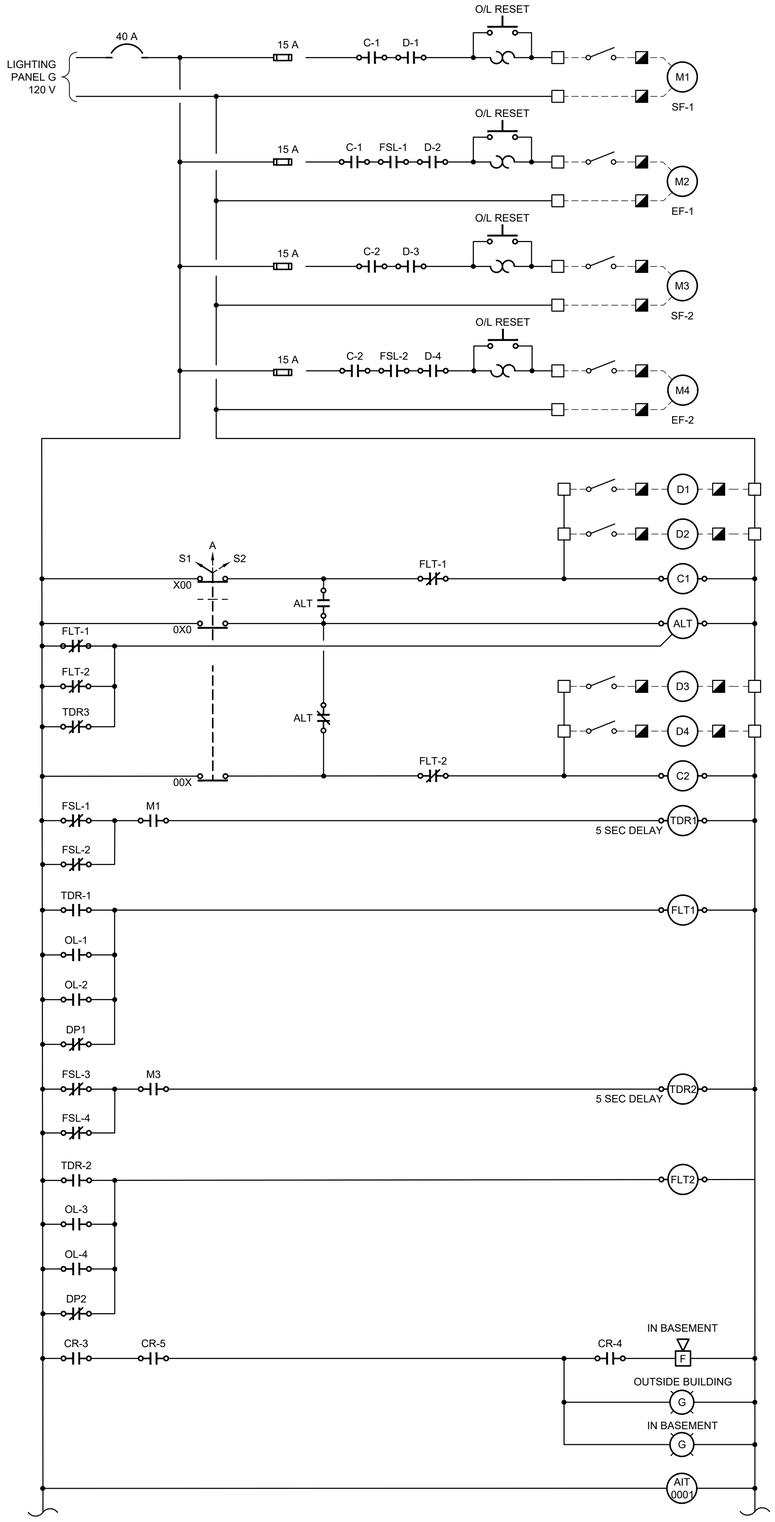
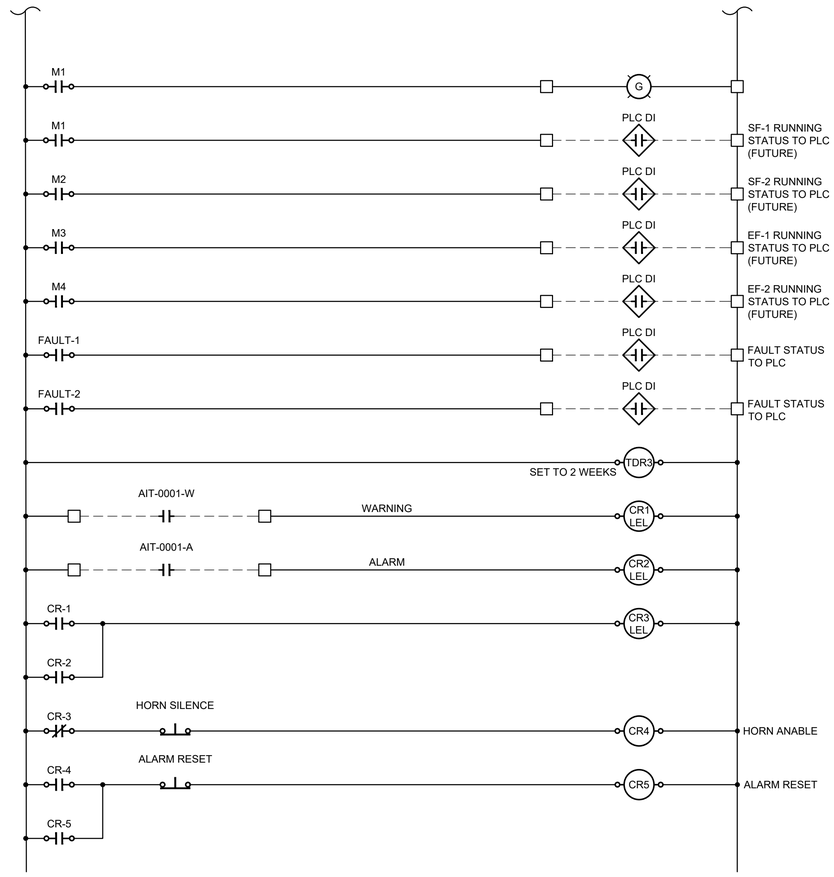
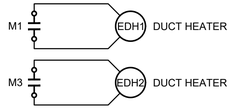
ELECTRICAL
PHOTOS
EXISTING SCREW PUMP AND DIGESTER BUILDING

DRAWING	REVISION	SHEET
5884-00-E-502	0	16







1 E-601 SCHEMATIC NTS

EXISTING SLUDGE BUILDING 400
VENTILATION CONTROL LCP-2

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

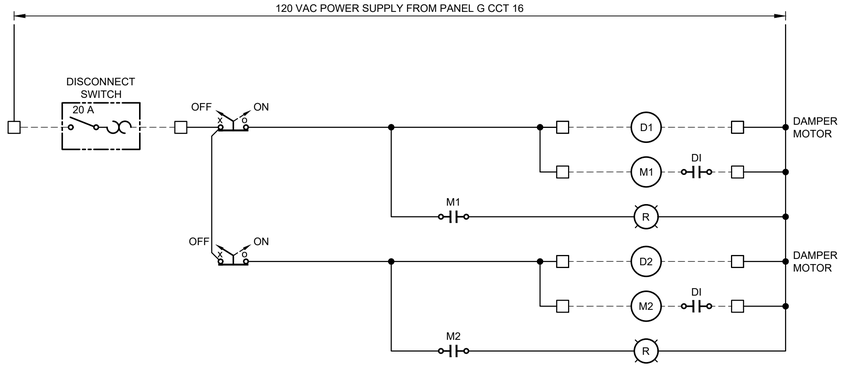
CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

ELECTRICAL
SCHEMATICS
STARTER CONTROL

DRAWING	REVISION	SHEET
5884-00-E-601	0	17



1 / E-601 SCHEMATIC NTS

EXISTING SCREW PUMP BUILDING 200
EXHAUST FAN EF-1 AND EF-2 CONTROL
PANEL LCP-3

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BEST MANAGED COMPANIES
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LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

Lake of the Woods KENORA

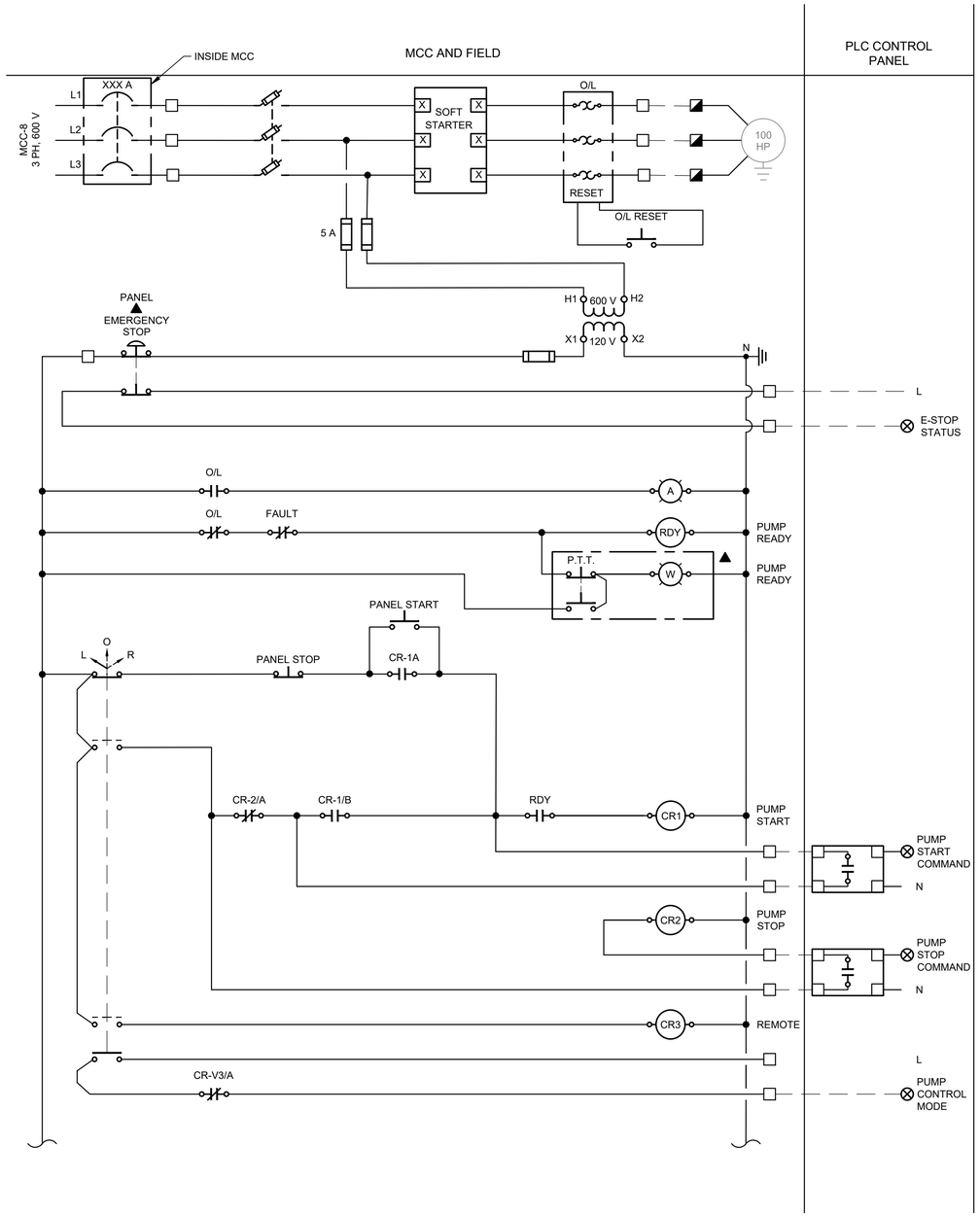
CITY OF KENORA

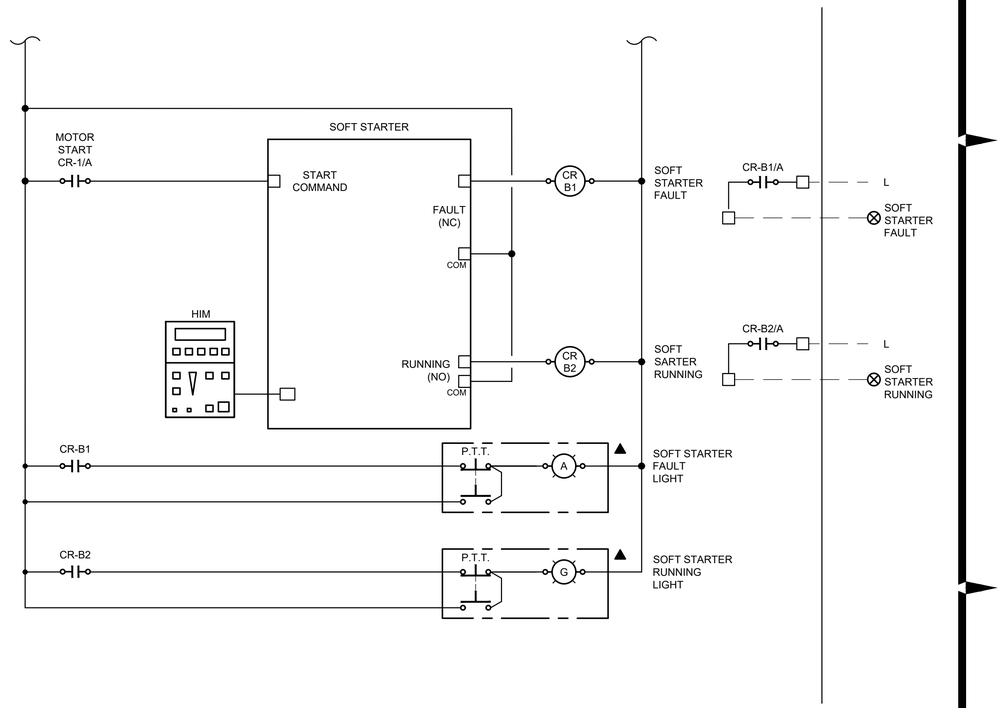
KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

ELECTRICAL
SCHEMATIC
EXHAUST FAN CONTROL PANEL

DRAWING	REVISION	SHEET
5884-00-E-602	0	18





1 E-602 **SCHEMATIC** NTS

EXISTING SCREW PUMP BUILDING 200
TYPICAL SOFT STARTER CONTROL
SUPERNATANT PUMP

NOTE:
SLUDGE PUMP: - XXX - 200 A
SUPERNATANT PUMP: - XXX - 25 A

Associated Engineering

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Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

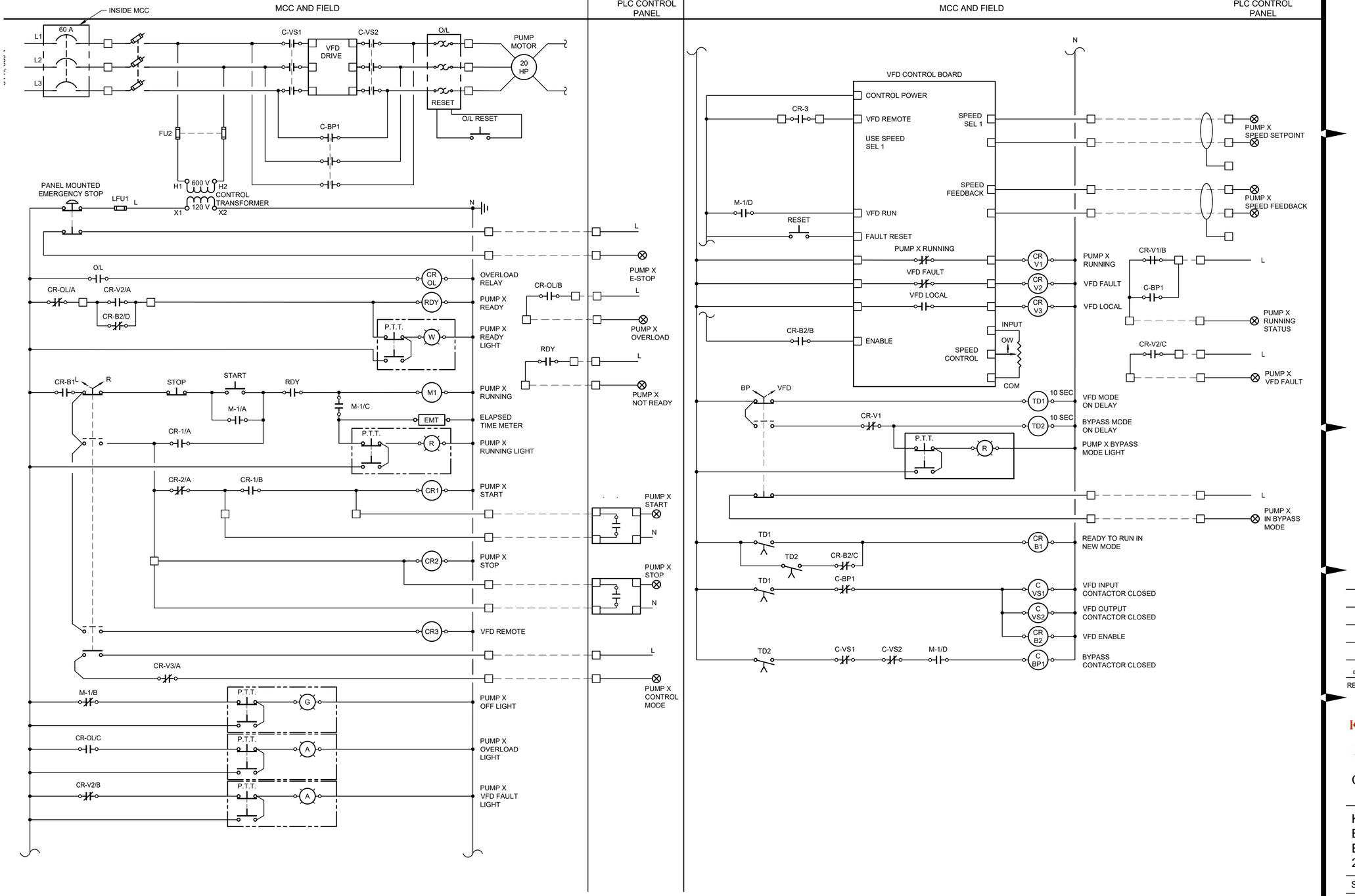
CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

ELECTRICAL
SCHEMATICS
STARTER CONTROL

DRAWING	REVISION	SHEET
5884-00-E-603	0	19



1 / E-603 SCHEMATIC NTS

EXISTING SLUDGE PUMP BUILDING 200
VFD STARTER CONTROL

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

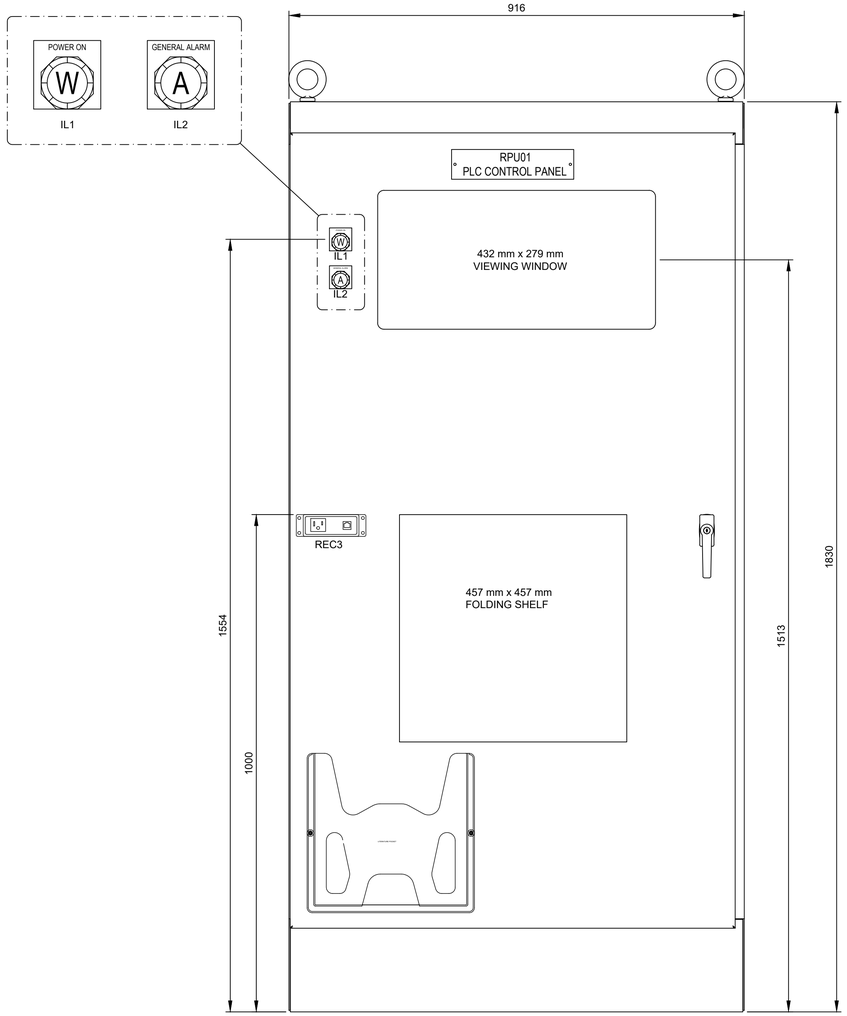
CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

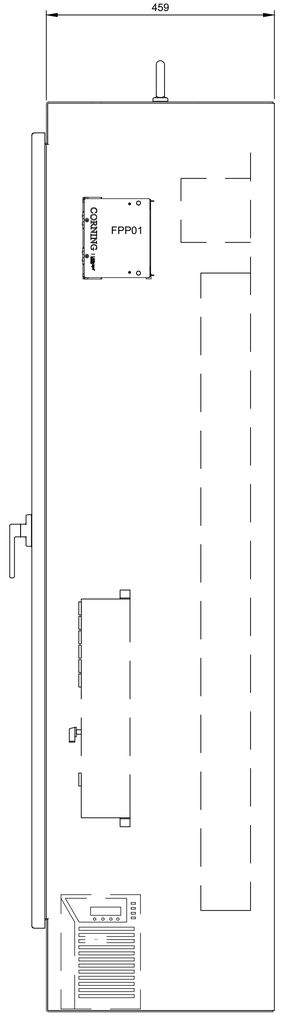
SCALE: AS SHOWN

ELECTRICAL
SCHEMATICS

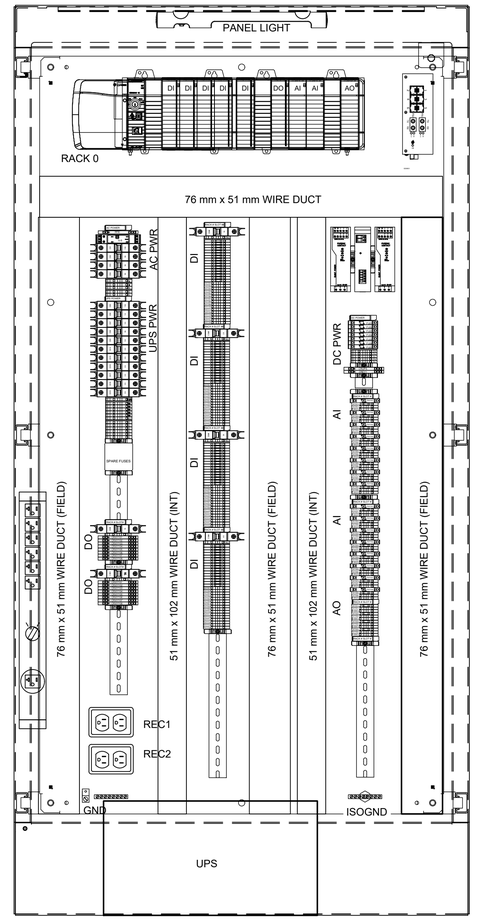
DRAWING	REVISION	SHEET
5884-00-E-604	0	20



PANEL FRONT VIEW



PANEL SIDE VIEW



PANEL INTERIOR VIEW

1 / EI-501 DETAIL NTS

ACP CONTROL PANEL LAYOUT

Associated Engineering

CANADA'S BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

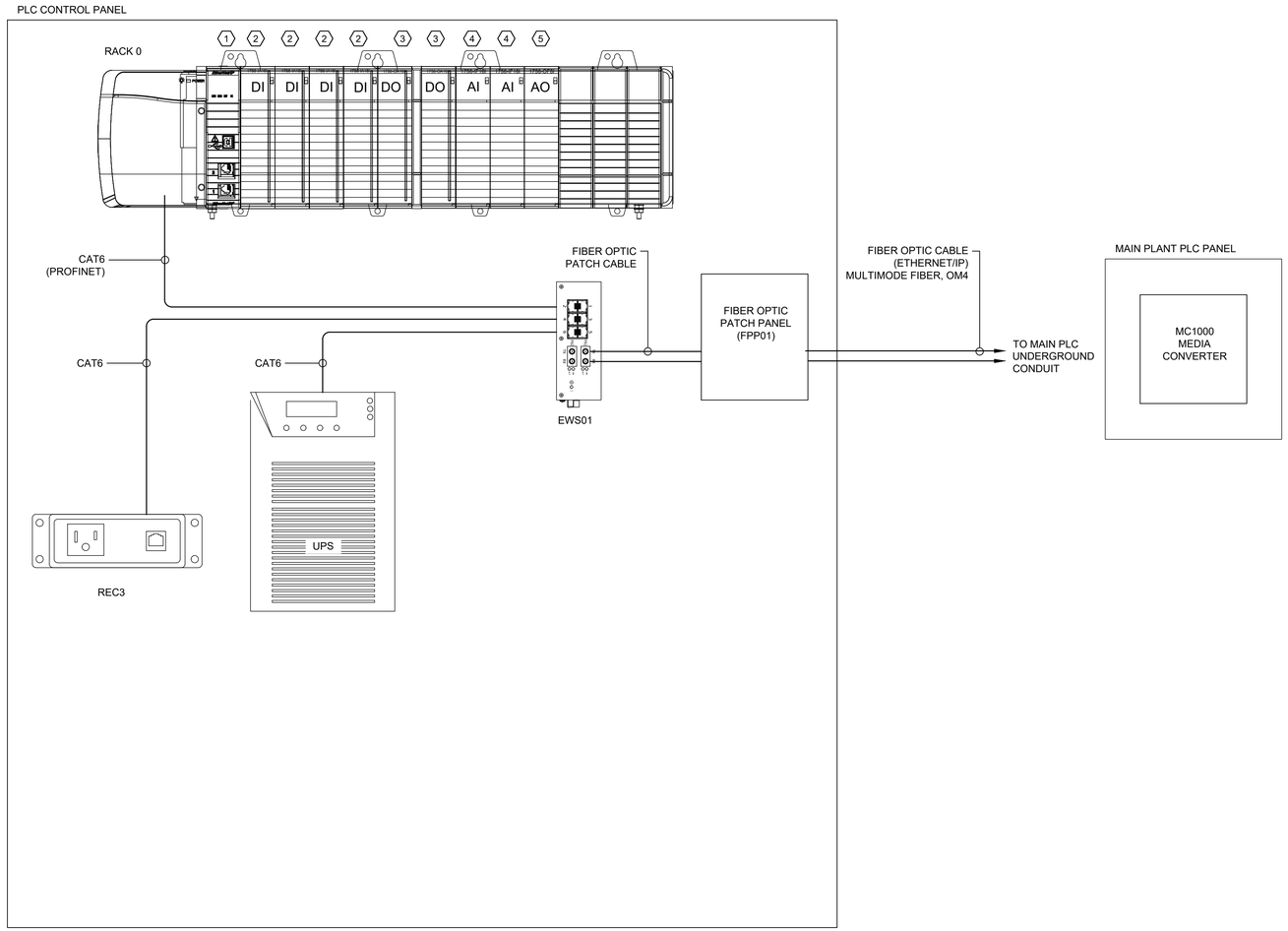
SCALE: AS SHOWN

INSTRUMENTATION
ACP PANEL LAYOUT

DRAWING	REVISION	SHEET
5884-00-EI-501	0	21

PLC BILL OF MATERIALS				
ITEM NO.	QUANTITY	MANUFACTURER	DESCRIPTION	CATALOGUE NO.
1	1	ALLEN BRADLEY	ETHERNET/IP BRIDGE MODULE (SERIES B)	1756-EN2TR
2	4	ALLEN BRADLEY	ISOLATED DIGITAL INPUT MODULE (16 PT.)	1756-IA16I
3	2	ALLEN BRADLEY	ISOLATED DIGITAL OUTPUT MODULE (16 PT.)	1756-OA16I
4	2	ALLEN BRADLEY	ANALOG INPUT MODULE (16 PT.)	1756-IF8I
5	1	ALLEN BRADLEY	ANALOG OUTPUT MODULE (8 PT.)	1756-OF8I
6	1	ALLEN BRADLEY	17 SLOT CHASSIS (SERIES B)	1756-A13/B
7	AS REQ'D	ALLEN BRADLEY	BLANK COVER MODULE	1756-N2
8	1	CORNING	WALL MOUNTABLE FIBER OPTIC PATCH PANEL C/W SC FIBER ADAPTER PANEL, CCH-CP12-GY	SPH-01P
.	1	N-TRON	MANAGED ETHERNET SWITCH, 6 RJ45 PORT, 2 FIBER PORT	708FX2

NOTE:
CONTRACTOR TO SUPPLY AND INSTALL MC 1000 MEDIA CONVERTER (PHOENIX) IN THE PLANT MAIN PLC PANEL.



1 / EI-502 DETAIL NTS
PLC CONTROL
PANEL LAYOUT

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

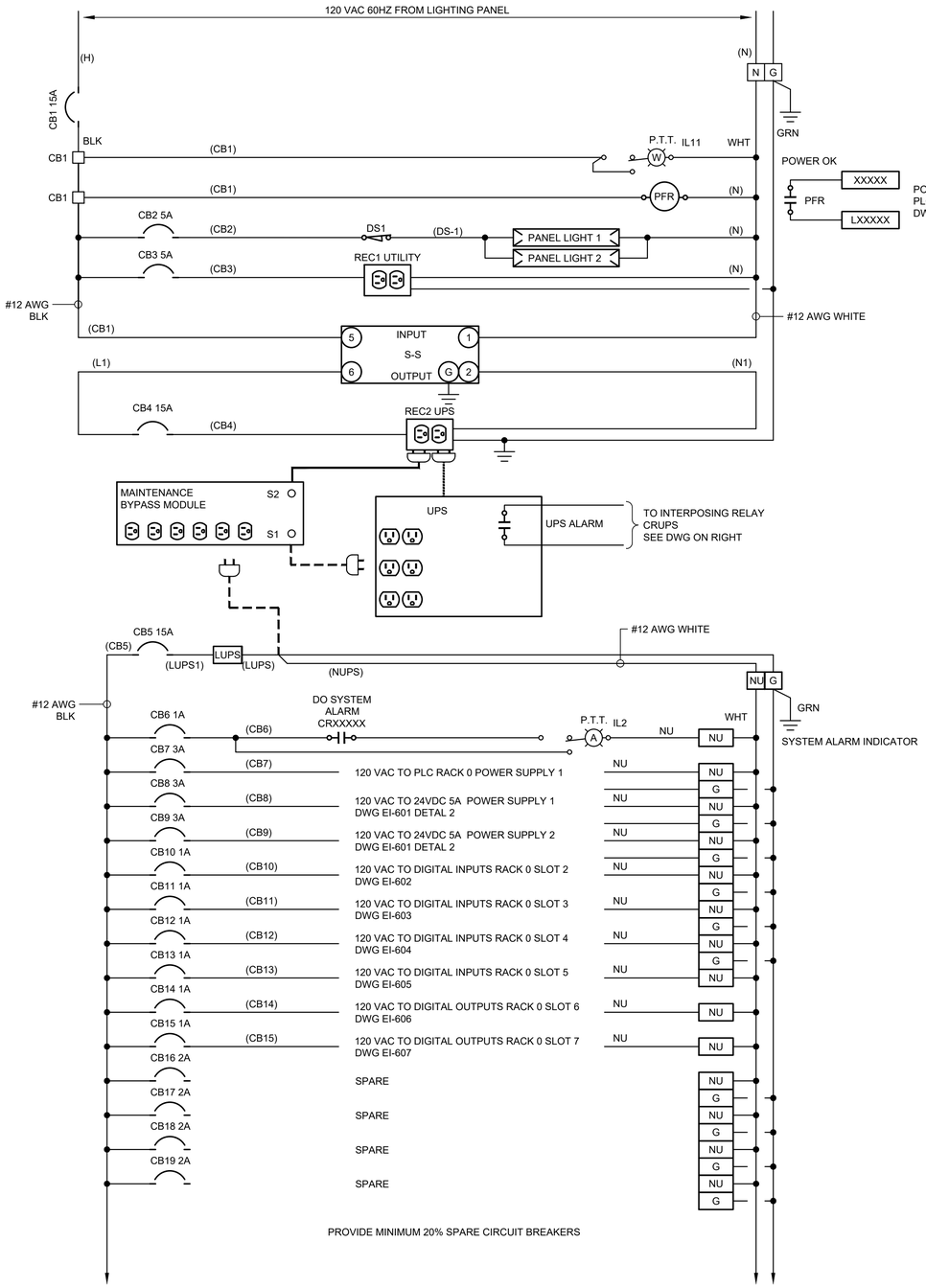
KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

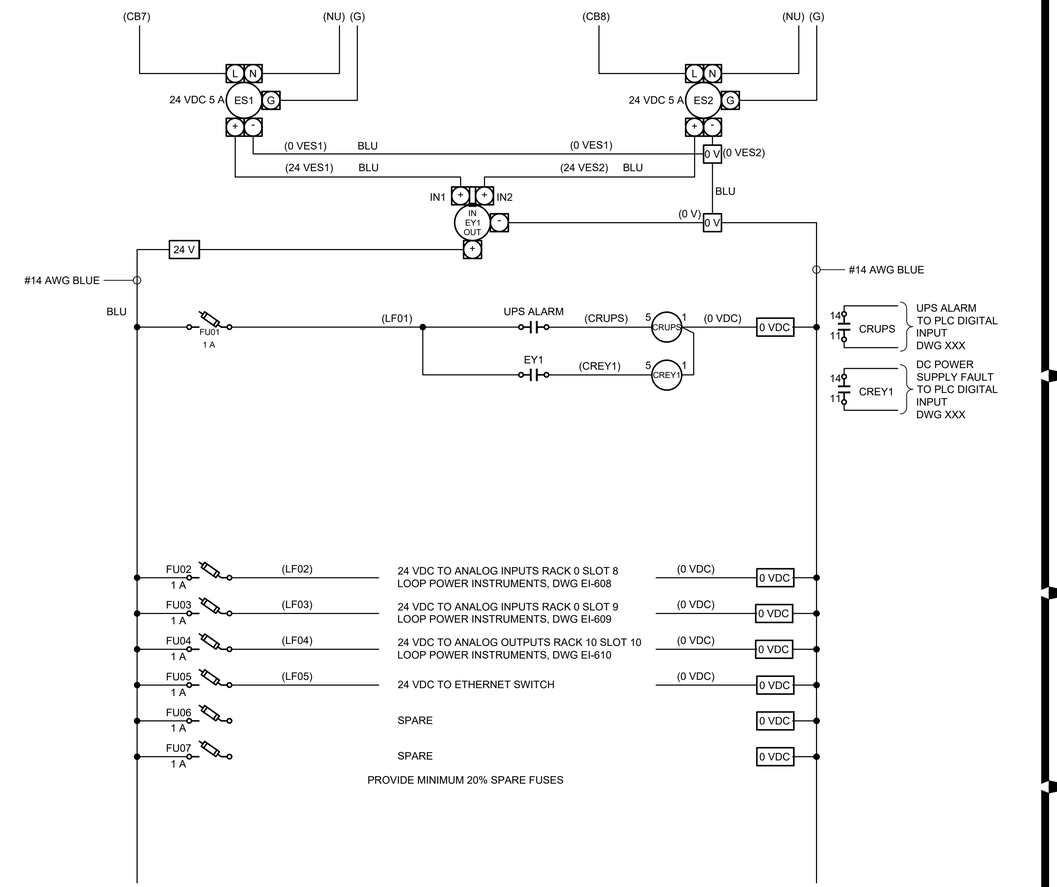
INSTRUMENTATION
PLC CONTROL PANEL LAYOUT

DRAWING	REVISION	SHEET
5884-00-EI-502	0	22

IF NOT 50 mm ADJUST SCALES
50 mm
SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE



1 EI-601 DIAGRAM NTS
POWER DISTRIBUTION



2 EI-601 DIAGRAM NTS
POWER DISTRIBUTION

Associated Engineering

CANADA'S BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

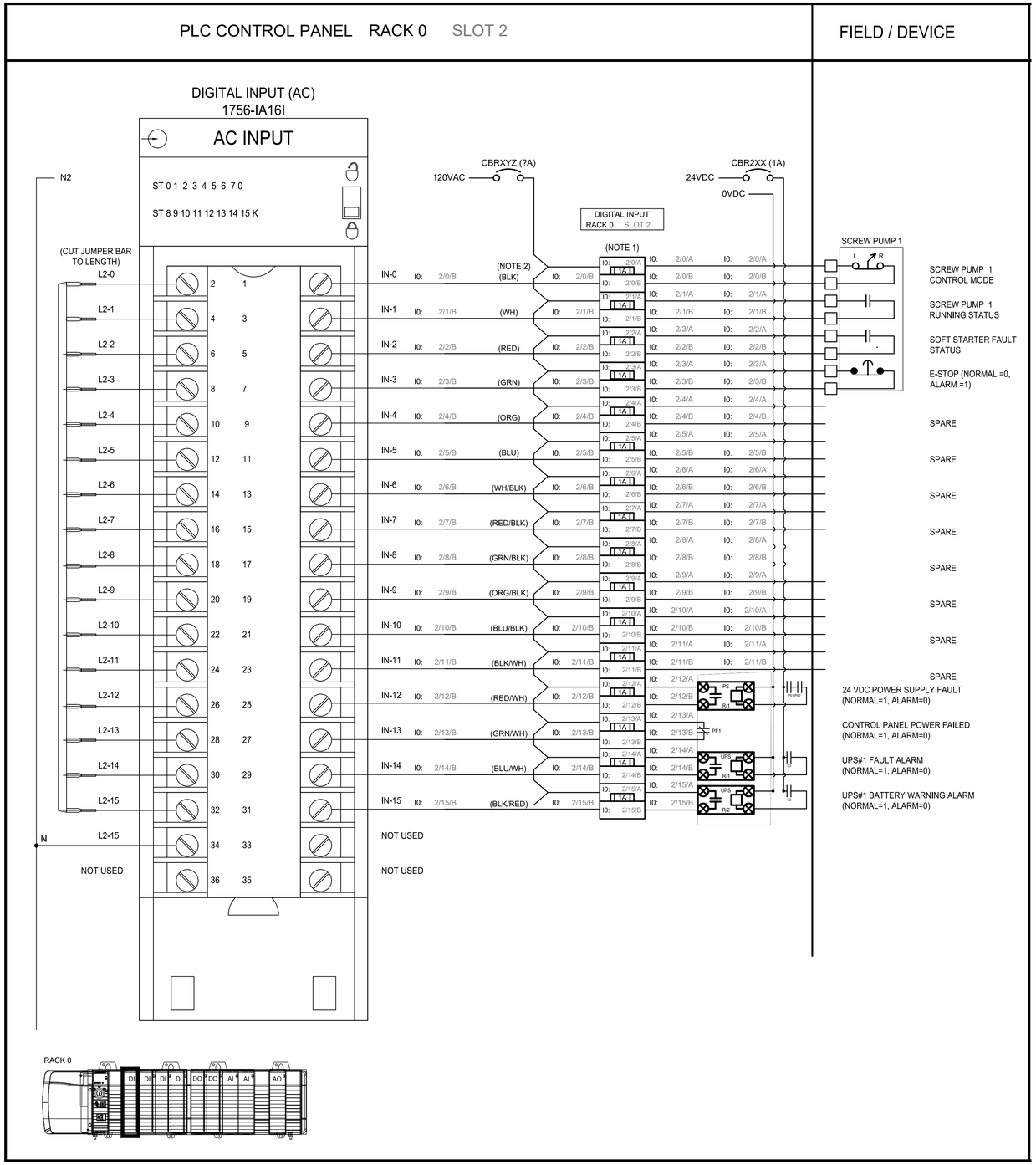
KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
PLC POWER DISTRIBUTION

DRAWING	REVISION	SHEET
5884-00-EI-601	0	23

PLOT DATE: 2025-05-28 11:14:34 AM
SAVE DATE: 2025-05-07 2:31:02 PM SAVED BY: TUMAK
DWG PATH: \\ae.ca\data\working\or\2024-5884-00\Inst\5884-00-ei-601.dwg



1 EI-602 DIAGRAM NTS
RACK 0 SLOT 2 DIGITAL INPUT MODULE

Associated Engineering
CANADA'S BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

Lake of the Woods KENORA

CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 0 SLOT 2 DIGITAL INPUT MODULE

DRAWING	REVISION	SHEET
5884-00-EI-602	0	24

PLC CONTROL PANEL RACK 0 SLOT 3 | FIELD / DEVICE

DIGITAL INPUT (AC)
1756-IA16I

AC INPUT

ST 0 1 2 3 4 5 6 7 0

ST 8 9 10 11 12 13 14 15 K

N2

120VAC

CBRXYZ (?A)

(CUT JUMPER BAR TO LENGTH)

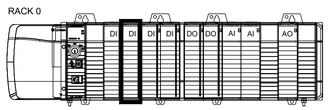
DIGITAL INPUT
RACK 0 SLOT 3

(NOTE 1)

L2-0	2	1	IN-0	I0: 3/0/B	(NOTE 2) (BLK)	I0: 3/0/B	I0: 3/0/A	I0: 3/0/A	SCREW PUMP 2 CONTROL MODE
L2-1	4	3	IN-1	I0: 3/1/B	(WH)	I0: 3/1/B	I0: 3/1/A	I0: 3/1/A	SCREW PUMP 2 RUNNING STATUS
L2-2	6	5	IN-2	I0: 3/2/B	(RED)	I0: 3/2/B	I0: 3/2/A	I0: 3/2/A	SOFT STARTER FAULT STATUS
L2-3	8	7	IN-3	I0: 3/3/B	(GRN)	I0: 3/3/B	I0: 3/3/A	I0: 3/3/A	E-STOP (NORMAL =0, ALARM =1)
L2-4	10	9	IN-4	I0: 3/4/B	(ORG)	I0: 3/4/B	I0: 3/4/A	I0: 3/4/B	SPARE
L2-5	12	11	IN-5	I0: 3/5/B	(BLU)	I0: 3/5/B	I0: 3/5/A	I0: 3/5/B	SPARE
L2-6	14	13	IN-6	I0: 3/6/B	(WH/BLK)	I0: 3/6/B	I0: 3/6/A	I0: 3/6/B	SPARE
L2-7	16	15	IN-7	I0: 3/7/B	(RED/BLK)	I0: 3/7/B	I0: 3/7/A	I0: 3/7/B	SPARE
L2-8	18	17	IN-8	I0: 3/8/B	(GRN/BLK)	I0: 3/8/B	I0: 3/8/A	I0: 3/8/B	SPARE
L2-9	20	19	IN-9	I0: 3/9/B	(ORG/BLK)	I0: 3/9/B	I0: 3/9/A	I0: 3/9/B	SPARE
L2-10	22	21	IN-10	I0: 3/10/B	(BLU/BLK)	I0: 3/10/B	I0: 3/10/A	I0: 3/10/B	SPARE
L2-11	24	23	IN-11	I0: 3/11/B	(BLK/WH)	I0: 3/11/B	I0: 3/11/A	I0: 3/11/B	SPARE
L2-12	26	25	IN-12	I0: 3/12/B	(RED/WH)	I0: 3/12/B	I0: 3/12/A	I0: 3/12/B	SPARE
L2-13	28	27	IN-13	I0: 3/13/B	(GRN/WH)	I0: 3/13/B	I0: 3/13/A	I0: 3/13/B	SPARE
L2-14	30	29	IN-14	I0: 3/14/B	(BLU/WH)	I0: 3/14/B	I0: 3/14/A	I0: 3/14/B	SPARE
L2-15	32	31	IN-15	I0: 3/15/B	(BLK/RED)	I0: 3/15/B	I0: 3/15/A	I0: 3/15/B	SPARE
N L2-15	34	33	NOT USED						
NOT USED	36	35	NOT USED						

SCREW PUMP 2

RACK 0



1 / EI-603 DIAGRAM NTS
RACK 0 SLOT 3 DIGITAL INPUT MODULE

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

CITY OF KENORA

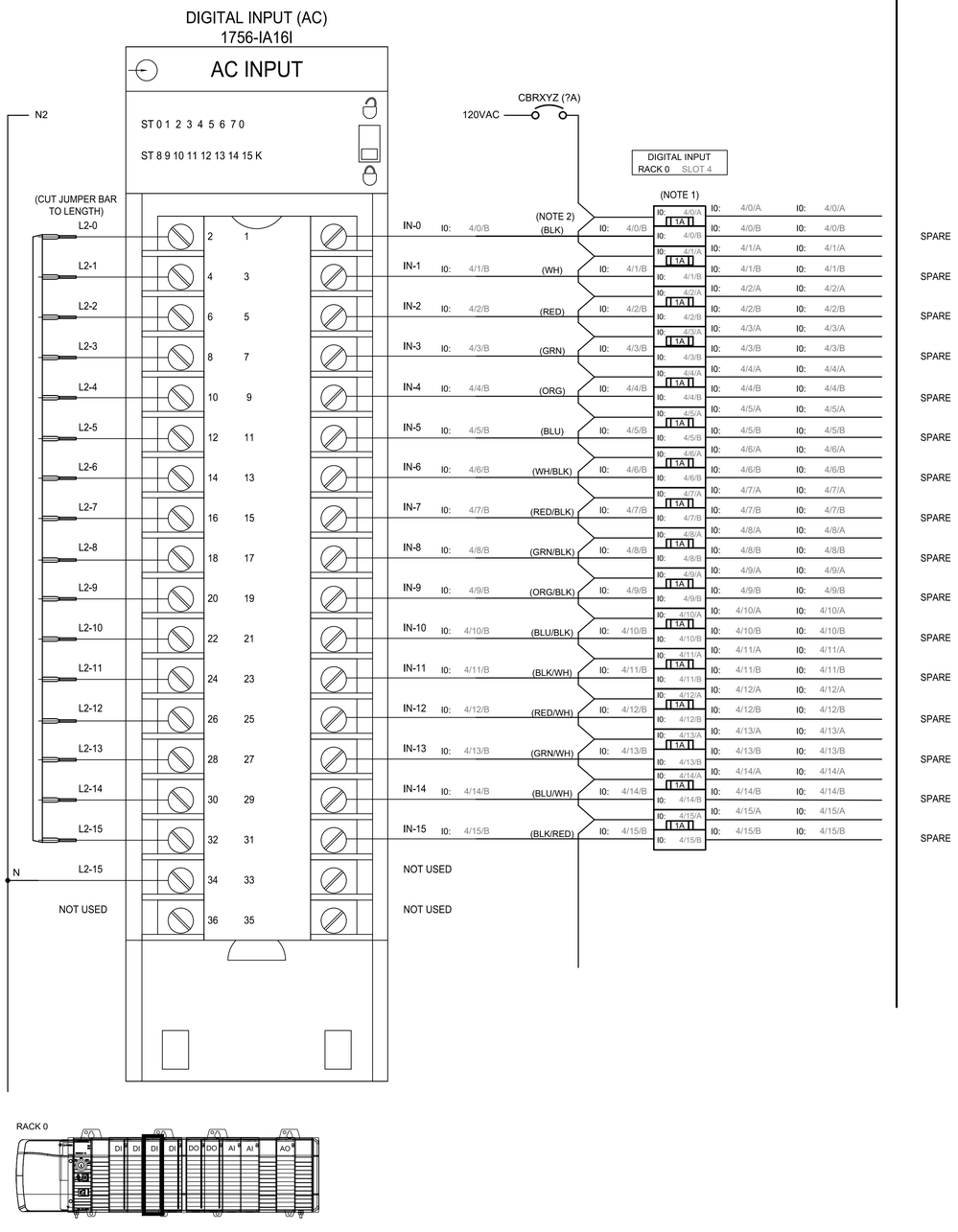
KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 0 SLOT 3 DIGITAL INPUT MODULE

DRAWING	REVISION	SHEET
5884-00-EI-603	0	25

PLC CONTROL PANEL RACK 0 SLOT 4	FIELD / DEVICE



1 EI-604 **DIAGRAM** NTS

RACK 0 SLOT 4 DIGITAL INPUT MODULE

Associated Engineering

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LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 0 SLOT 4 DIGITAL INPUT MODULE

DRAWING	REVISION	SHEET
5884-00-EI-604	0	26

DIGITAL INPUT (AC)
1756-IA16I

AC INPUT

ST 0 1 2 3 4 5 6 7 0

ST 8 9 10 11 12 13 14 15 K

N2

(CUT JUMPER BAR TO LENGTH)

CBRXYZ (?A)

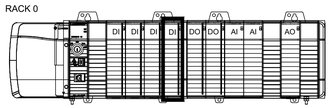
120VAC

DIGITAL INPUT
RACK 0 SLOT 5

(NOTE 1)

L2-0	2	1	IN-0	I0: 5/0B	(NOTE 2) (BLK)	I0: 5/0B	1A	SPARE
L2-1	4	3	IN-1	I0: 5/1B	(WH)	I0: 5/1B	1A	SPARE
L2-2	6	5	IN-2	I0: 5/2B	(RED)	I0: 5/2B	1A	SPARE
L2-3	8	7	IN-3	I0: 5/3B	(GRN)	I0: 5/3B	1A	SPARE
L2-4	10	9	IN-4	I0: 5/4B	(ORG)	I0: 5/4B	1A	SPARE
L2-5	12	11	IN-5	I0: 5/5B	(BLU)	I0: 5/5B	1A	SPARE
L2-6	14	13	IN-6	I0: 5/6B	(WH/BLK)	I0: 5/6B	1A	SPARE
L2-7	16	15	IN-7	I0: 5/7B	(RED/BLK)	I0: 5/7B	1A	SPARE
L2-8	18	17	IN-8	I0: 5/8B	(GRN/BLK)	I0: 5/8B	1A	SPARE
L2-9	20	19	IN-9	I0: 5/9B	(ORG/BLK)	I0: 5/9B	1A	SPARE
L2-10	22	21	IN-10	I0: 5/10B	(BLU/BLK)	I0: 5/10B	1A	SPARE
L2-11	24	23	IN-11	I0: 5/11B	(BLK/WH)	I0: 5/11B	1A	SPARE
L2-12	26	25	IN-12	I0: 5/12B	(RED/WH)	I0: 5/12B	1A	SPARE
L2-13	28	27	IN-13	I0: 5/13B	(GRN/WH)	I0: 5/13B	1A	SPARE
L2-14	30	29	IN-14	I0: 5/14B	(BLU/WH)	I0: 5/14B	1A	SPARE
L2-15	32	31	IN-15	I0: 5/15B	(BLK/RED)	I0: 5/15B	1A	SPARE
N			NOT USED					
L2-15	34	33						
NOT USED	36	35						

RACK 0



1 EI-605 DIAGRAM NTS
RACK 0 SLOT 5 DIGITAL INPUT MODULE

Associated Engineering

CANADA'S BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 0 SLOT 5 DIGITAL INPUT MODULE

DRAWING	REVISION	SHEET
5884-00-EI-605	0	27

DIGITAL OUTPUT (AC)
1756-OA16I

AC OUTPUT

CBRXYZ (?A) — 120VAC

ST 0 1 2 3 4 5 6 7 0

ST 8 9 10 11 12 13 14 15 K

(CUT JUMPER BAR TO LENGTH)

N2

DIGITAL INPUT
RACK 0 SLOT 6

(NOTE 1)

L1-0	2	1	OUT-0 O0: 6/0/B	(NOTE 2) (BLK)	CR-0: 6/0 O0: 6/0/A	PUMP 1 START COMMNAD
L1-1	4	3	OUT-1 O0: 6/1/B	(WH)	CR-0: 6/1 O0: 6/0/B	
L1-2	6	5	OUT-2 O0: 6/2/B	(RED)	CR-0: 6/2 O0: 6/1/A	PUMP 1 STOP COMMAND
L1-3	8	7	OUT-3 O0: 6/3/B	(GRN)	CR-0: 6/3 O0: 6/1/B	
L1-4	10	9	OUT-4 O0: 6/4/B	(ORG)	CR-0: 6/4 O0: 6/2/A	SPARE
L1-5	12	11	OUT-5 O0: 6/5/B	(BLU)	CR-0: 6/5 O0: 6/2/B	
L1-6	14	13	OUT-6 O0: 6/6/B	(WH/BLK)	CR-0: 6/6 O0: 6/3/A	SPARE
L1-7	16	15	OUT-7 O0: 6/7/B	(RED/BLK)	CR-0: 6/7 O0: 6/3/B	
L1-8	18	17	OUT-8 O0: 6/8/B	(GRN/BLK)	CR-0: 6/8 O0: 6/4/A	SPARE
L1-9	20	19	OUT-9 O0: 6/9/B	(ORG/BLK)	CR-0: 6/9 O0: 6/4/B	
L1-10	22	21	OUT-10 O0: 6/10/B	(BLU/BLK)	CR-0: 6/10 O0: 6/5/A	SPARE
L1-11	24	23	OUT-11 O0: 6/11/B	(BLK/WH)	CR-0: 6/11 O0: 6/5/B	
L1-12	26	25	OUT-12 O0: 6/12/B	(RED/WH)	CR-0: 6/12 O0: 6/6/A	SPARE
L1-13	28	27	OUT-13 O0: 6/13/B	(GRN/WH)	CR-0: 6/13 O0: 6/6/B	
L1-14	30	29	OUT-14 O0: 6/14/B	(BLU/WH)	CR-0: 6/14 O0: 6/7/A	SPARE
L1-15	32	31	OUT-15 O0: 6/15/B	(BLK/RED)	CR-0: 6/15 O0: 6/7/B	
L1-15	34	33	NOT USED			
NOT USED	36	35	NOT USED			

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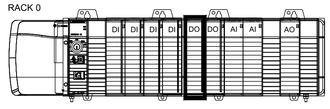

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RACK 0 SLOT 6 DIGITAL OUTPUT MODULE

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 0 SLOT 6 DIGITAL OUTPUT MODULE

DRAWING	REVISION	SHEET
5884-00-EI-606	0	28

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

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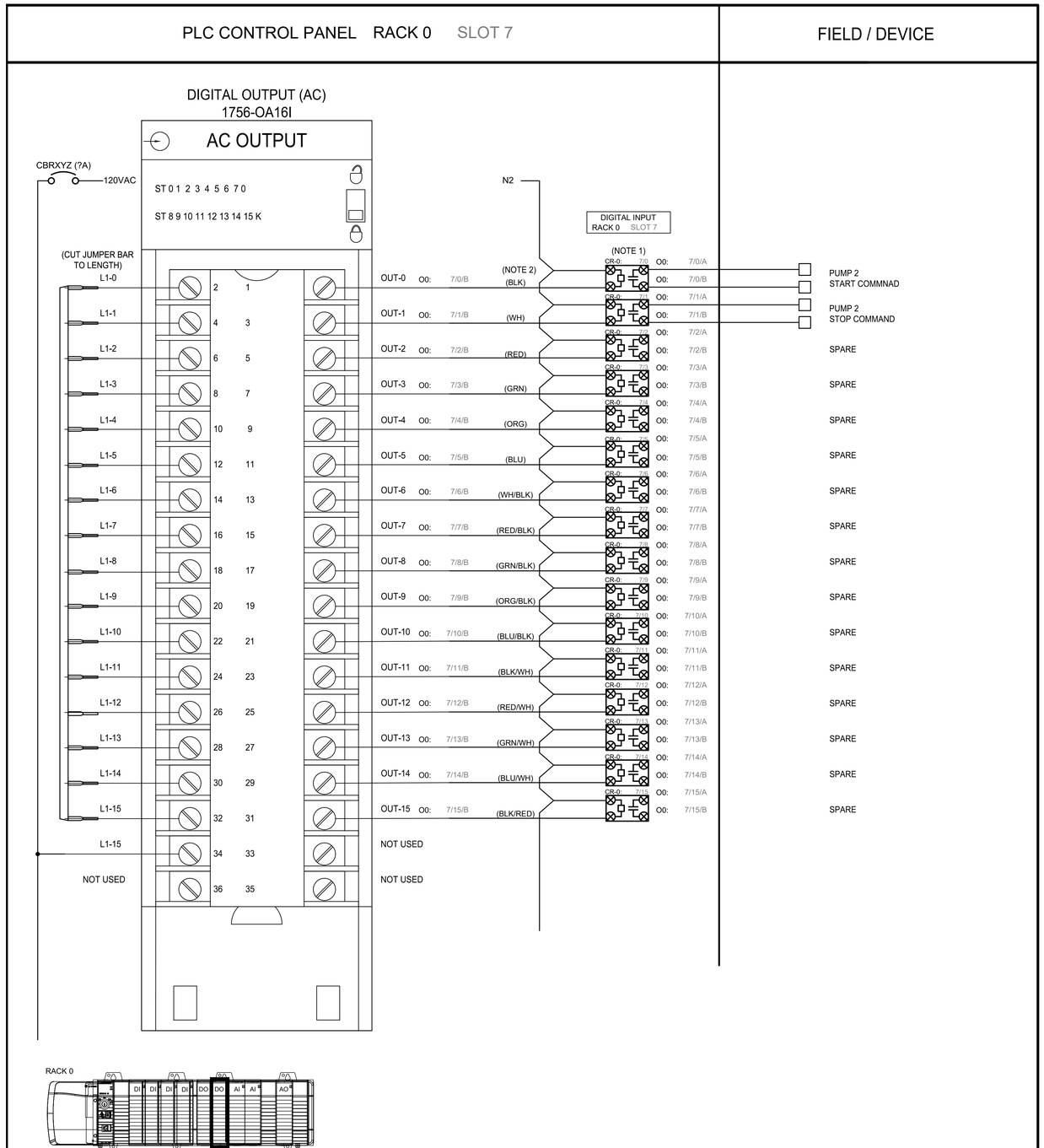


1 EI-607 DIAGRAM NTS

RACK 0 SLOT 7 DIGITAL OUTPUT MODULE

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
100169270
2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

CITY OF KENORA

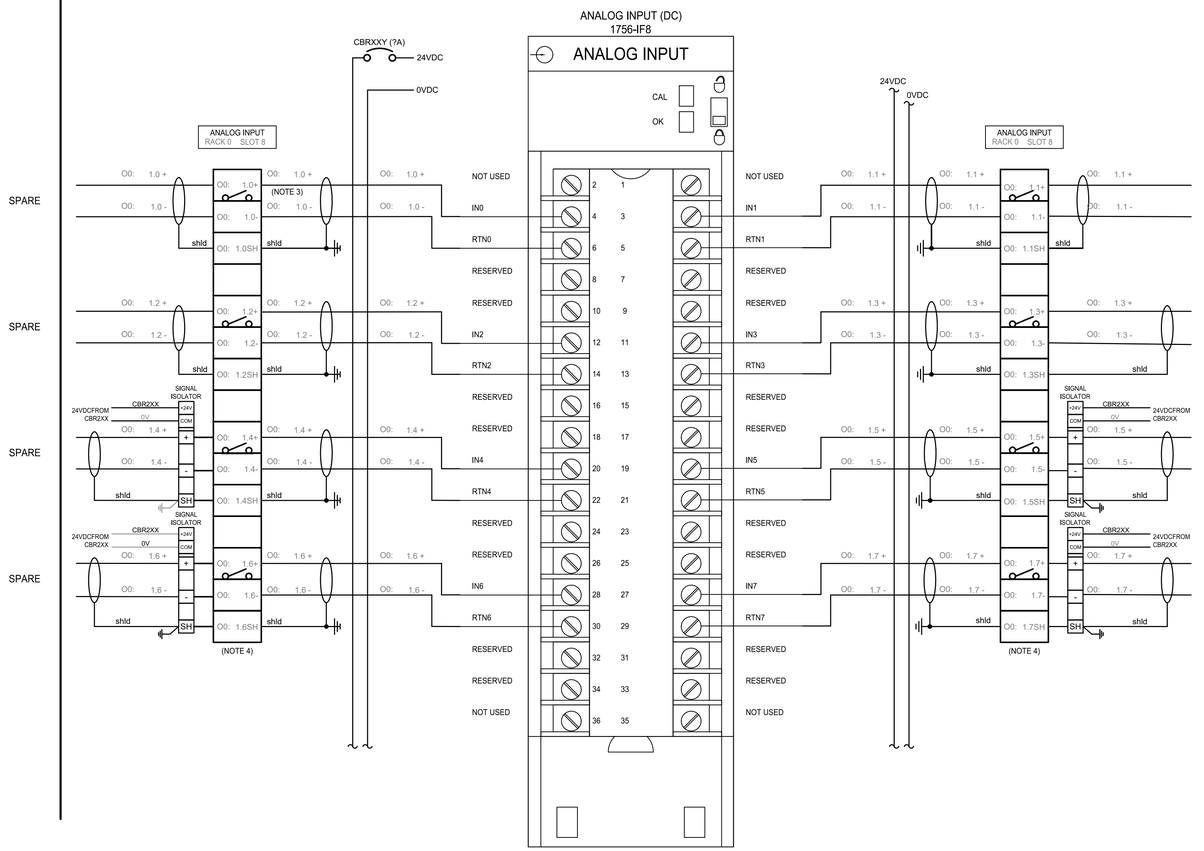
KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

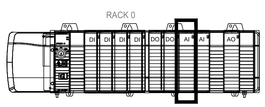
SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 0 SLOT 7 DIGITAL OUTPUT MODULE

DRAWING	REVISION	SHEET
5884-00-EI-607	0	29

FIELD / DEVICE	PLC CONTROL PANEL RACK 0 SLOT 8	FIELD / DEVICE





1 / EI-608 DIAGRAM NTS
RACK 0 SLOT 8 ANALOG INPUT MODULE

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BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
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2025-05-30
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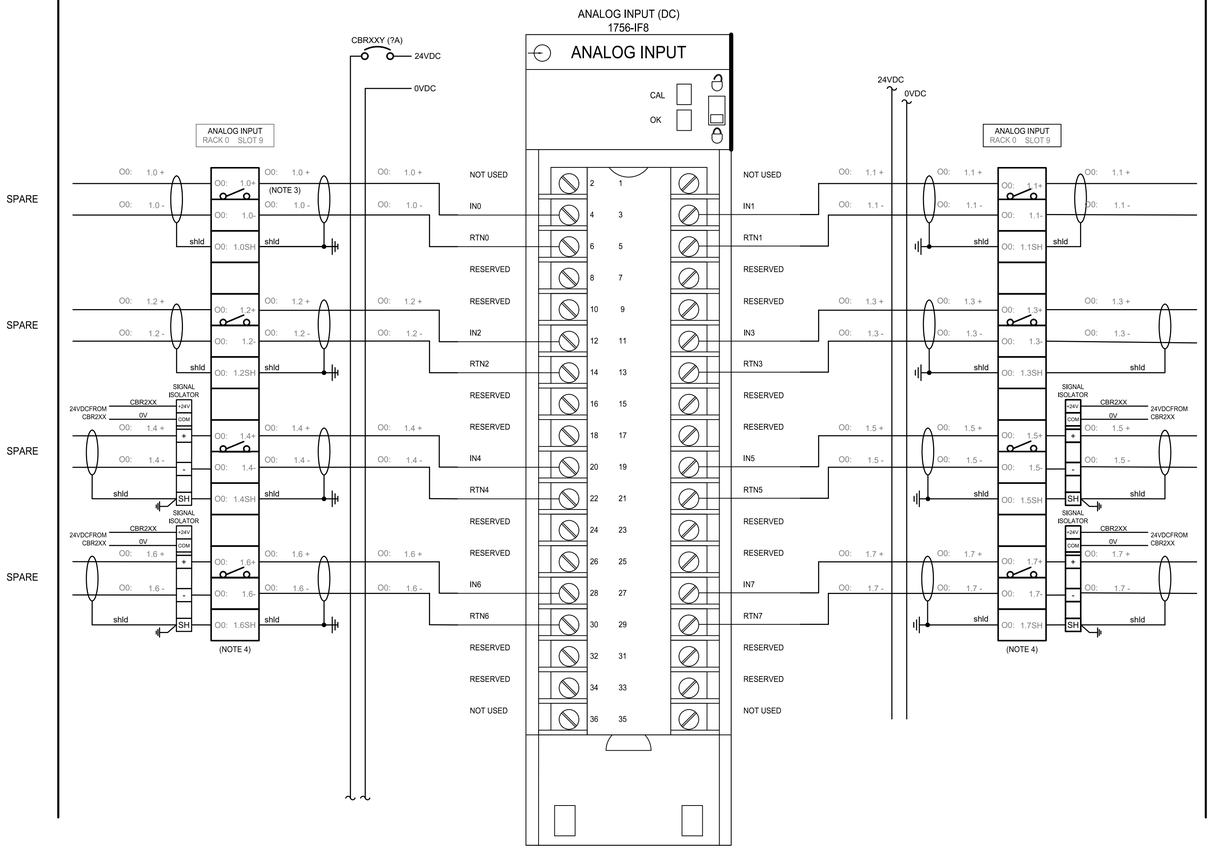
SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 0 SLOT 8 ANALOG INPUT MODULE

DRAWING	REVISION	SHEET
5884-00-EI-608	0	30

FIELD / DEVICE	PLC CONTROL PANEL RACK 0 SLOT 9	FIELD / DEVICE



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RACK 0 SLOT 9 ANALOG INPUT MODULE

REV	DATE	DESIGN	DRAWN	DESCRIPTION
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CITY OF KENORA

KENORA WWTP
BUILDING 200 AND 400
ELECTRICAL UPGRADES
20245884-00

SCALE: AS SHOWN

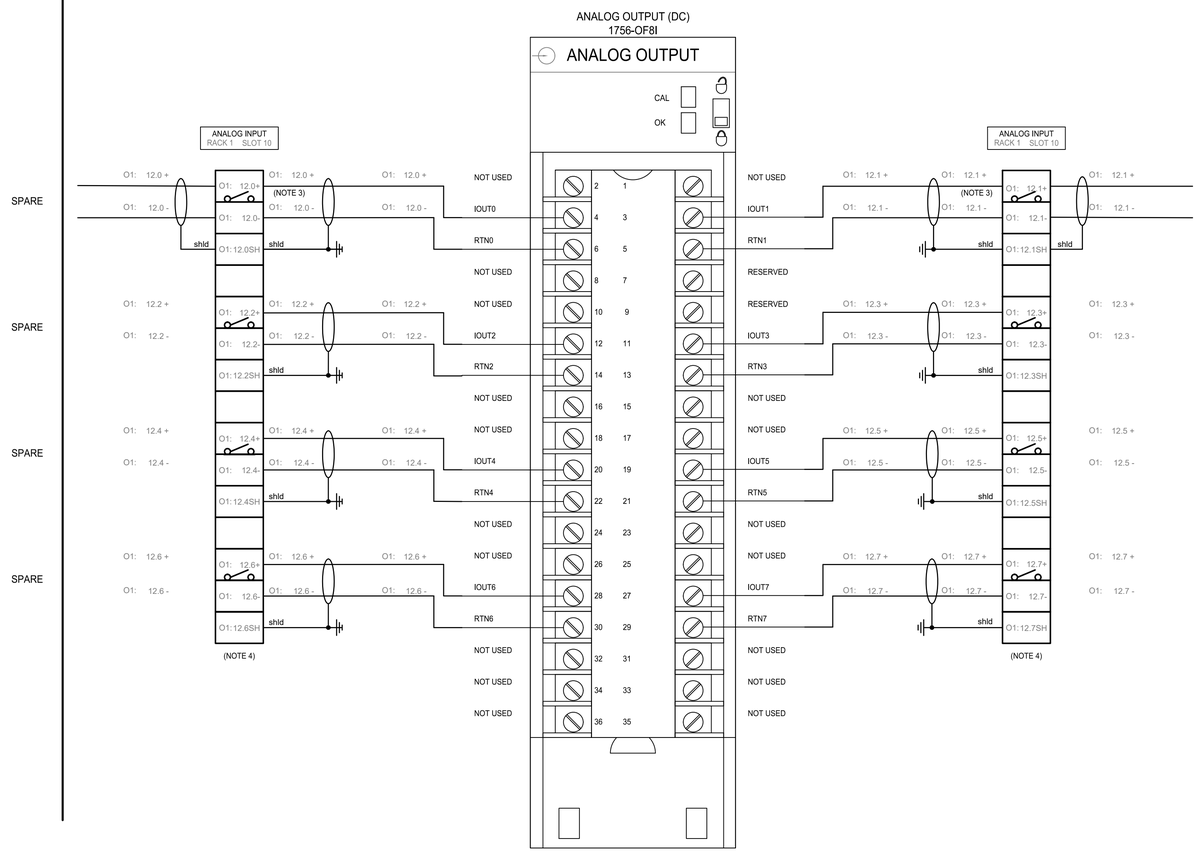
INSTRUMENTATION
DIAGRAM
RACK 0 SLOT 9 ANALOG INPUT MODULE

DRAWING	REVISION	SHEET
5884-00-EI-609	0	31

IF NOT 50 mm ADJUST SCALES
50 mm

SCALE(S) SHOWN ARE INTENDED FOR ANSI D (22X34) SIZE DRAWINGS, TABLOID (11X17) SIZE DRAWINGS ARE 1/2 OF SCALE(S) SHOWN UNLESS NOTED OTHERWISE

FIELD / DEVICE	PLC CONTROL PANEL RACK 1 SLOT 10	FIELD / DEVICE



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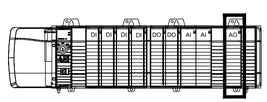

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Associated Engineering

BEST MANAGED COMPANIES
Platinum member

LICENSED PROFESSIONAL ENGINEER
D. Y. BAI
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2025-05-30
PROVINCE OF ONTARIO

REV	DATE	DESIGN	DRAWN	DESCRIPTION
0	2025MAY28	G. DHILLON	K. TUMA	ISSUED FOR TENDER

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20245884-00

SCALE: AS SHOWN

INSTRUMENTATION
DIAGRAM
RACK 0 SLOT 10 ANALOG OUTPUT MODULE

DRAWING	REVISION	SHEET
5884-00-EI-610	0	32

CCDC 2

CCDC 2

Stipulated Price Contract

2020

CITY OF KENORA Phase 1 WTP Pump Replacement & WWTP Electrical Upgrades

Apply a CCDC 2 copyright seal here. The application of the seal demonstrates the intention of the party proposing the use of this document that it be an accurate and unamended form of CCDC 2 – 2020 except to the extent that any alterations, additions or modifications are set forth in supplementary conditions.

CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE
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CCDC 2 STIPULATED PRICE CONTRACT

TABLE OF CONTENTS

CCDC 2 is the product of a consensus-building process aimed at balancing the interests of all parties on the construction project. It reflects recommended industry practices. The CCDC and its constituent member organizations do not accept any responsibility or liability for loss or damage which may be suffered as a result of the use or interpretation of CCDC 2.

AGREEMENT BETWEEN OWNER AND CONTRACTOR
For use when a stipulated price is the basis of payment.

This Agreement made on day of in the year .
by and between the parties

hereinafter called the *"Owner"*

and

hereinafter called the "*Contractor*"

The *Owner* and the *Contractor* agree as follows:

ARTICLE A-1 THE WORK

The *Contractor* shall:

1.1 perform the *Work* required by the *Contract Documents* for *(insert below the description or title of the Work)*

located at *(insert below the Place of the Work)*

for which the Agreement has been signed by the parties, and for which *(insert below the name of the Consultant)*

is acting as and is hereinafter called the "*Consultant*" and

1.2 do and fulfill everything indicated by the *Contract Documents*, and

1.3 commence the *Work* by the day of in the year and, subject to adjustment in *Contract Time* as provided for in the *Contract Documents*, attain *Ready-for-Takeover*, by the day of in the year .

ARTICLE A-2 AGREEMENTS AND AMENDMENTS

2.1 The *Contract* supersedes all prior negotiations, representations or agreements, either written or oral, relating in any manner to the *Work*, including the bid documents that are not expressly listed in Article A-3 of the Agreement – CONTRACT DOCUMENTS.

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

ARTICLE A-3 CONTRACT DOCUMENTS

3.1 The following are the *Contract Documents* referred to in Article A-1 of the Agreement – THE WORK:

- Agreement between *Owner* and *Contractor*
- Definitions
- General Conditions
- *

* *(Insert here, attaching additional pages if required, a list identifying all other Contract Documents e.g. supplementary conditions; Division 01 of the Specifications – GENERAL REQUIREMENTS; Project information that the Contractor may rely upon; technical Specifications, giving a list of contents with section numbers and titles, number of pages and date; material finishing schedules; Drawings, giving drawing number, title, date, revision date or mark; addenda, giving title, number, date; time schedule)*

ARTICLE A-4 CONTRACT PRICE

4.1 The *Contract Price*, which excludes *Value Added Taxes*, is:

/100 dollars $

4.2 *Value Added Taxes* (of _____ %) payable by the *Owner* to the *Contractor* are:

/100 dollars $

4.3 Total amount payable by the *Owner* to the *Contractor* for the *Work* is:

/100 dollars $

4.4 These amounts shall be subject to adjustments as provided in the *Contract Documents*.

4.5 All amounts are in Canadian funds.

ARTICLE A-5 PAYMENT

5.1 Subject to the provisions of the *Contract Documents* and *Payment Legislation*, and in accordance with legislation and statutory regulations respecting holdback percentages, the *Owner* shall:

.1 make progress payments to the *Contractor* on account of the *Contract Price* when due in the amount certified by the *Consultant* unless otherwise prescribed by *Payment Legislation* together with such *Value Added Taxes* as may be applicable to such payments,

.2 upon *Substantial Performance of the Work*, pay to the *Contractor* the unpaid balance of the holdback amount when due together with such *Value Added Taxes* as may be applicable to such payment, and

.3 upon the issuance of the final certificate for payment, pay to the *Contractor* the unpaid balance of the *Contract Price* when due together with such *Value Added Taxes* as may be applicable to such payment.

5.2 Interest

.1 Should either party fail to make payments as they become due under the terms of the *Contract* or in an award by adjudication, arbitration or court, interest at the following rates on such unpaid amounts shall also become due and payable until payment:

(1) 2% per annum above the prime rate for the first 60 days.

(2) 4% per annum above the prime rate after the first 60 days.

Such interest shall be compounded on a monthly basis. The prime rate shall be the rate of interest quoted by

(Insert name of chartered lending institution whose prime rate is to be used)

for prime business loans as it may change from time to time.

.2 Interest shall apply at the rate and in the manner prescribed by paragraph 5.2.1 of this Article on the settlement amount of any claim in dispute that is resolved either pursuant to Part 8 of the General Conditions – DISPUTE RESOLUTION or otherwise, from the date the amount would have been due and payable under the *Contract*, had it not been in dispute, until the date it is paid.

ARTICLE A-6 RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING

6.1 *Notices in Writing* will be addressed to the recipient at the address set out below.

6.2 The delivery of a *Notice in Writing* will be by hand, by courier, by prepaid first class mail, or by other form of electronic communication during the transmission of which no indication of failure of receipt is communicated to the sender.

6.3 A *Notice in Writing* delivered by one party in accordance with this *Contract* will be deemed to have been received by the other party on the date of delivery if delivered by hand or courier, or if sent by mail it will be deemed to have been received five calendar days after the date on which it was mailed, provided that if either such day is not a *Working Day*, then the *Notice in Writing* will be deemed to have been received on the *Working Day* next following such day.

6.4 A *Notice in Writing* sent by any form of electronic communication will be deemed to have been received on the date of its transmission provided that if such day is not a *Working Day* or if it is received after the end of normal business hours on the date of its transmission at the place of receipt, then it will be deemed to have been received at the opening of business at the place of receipt on the first *Working Day* next following the transmission thereof.

6.5 An address for a party may be changed by *Notice in Writing* to the other party setting out the new address in accordance with this Article.

Owner

*name of Owner**

address

email address

Contractor

*name of Contractor**

address

email address

Consultant

*name of Consultant**

address

email address

** If it is intended that a specific individual must receive the notice, that individual's name shall be indicated.*

ARTICLE A-7 LANGUAGE OF THE CONTRACT

7.1 When the *Contract Documents* are prepared in both the English and French languages, it is agreed that in the event of any apparent discrepancy between the English and French versions, the English / French # language shall prevail.
 # Complete this statement by striking out inapplicable term.

7.2 This Agreement is drawn in English at the request of the parties hereto. La présente convention est rédigée en anglais à la demande des parties.

ARTICLE A-8 SUCCESSION

8.1 The *Contract* shall enure to the benefit of and be binding upon the parties hereto, their respective heirs, legal representatives, successors, and assigns.

In witness whereof the parties hereto have executed this Agreement by the hands of their duly authorized representatives.

SIGNED AND DELIVERED
in the presence of:

WITNESS

OWNER

_____
name of Owner

_____
signature

_____
signature

_____
name of person signing

_____
name and title of person signing

WITNESS

CONTRACTOR

_____
name of Contractor

_____
signature

_____
signature

_____
name of person signing

_____
name and title of person signing

N.B. *Where legal jurisdiction, local practice or Owner or Contractor requirement calls for:*

(a) proof of authority to execute this document, attach such proof of authority in the form of a certified copy of a resolution naming the representative(s) authorized to sign the Agreement for and on behalf of the corporation or partnership; or

(b) the affixing of a corporate seal, this Agreement should be properly sealed.

DEFINITIONS

The following Definitions shall apply to all *Contract Documents*.

Change Directive

A *Change Directive* is a written instruction prepared by the *Consultant* and signed by the *Owner* directing the *Contractor* to proceed with a change in the *Work* within the general scope of the *Contract Documents* prior to the *Owner* and the *Contractor* agreeing upon adjustments in the *Contract Price* and the *Contract Time*.

Change Order

A *Change Order* is a written amendment to the *Contract* prepared by the *Consultant* and signed by the *Owner* and the *Contractor* stating their agreement upon:

- a change in the *Work*;
- the method of adjustment or the amount of the adjustment in the *Contract Price*, if any; and
- the extent of the adjustment in the *Contract Time*, if any.

Construction Equipment

Construction Equipment means all machinery and equipment, either operated or not operated, that is required for preparing, fabricating, conveying, erecting, or otherwise performing the *Work* but is not incorporated into the *Work.*

Consultant

The *Consultant* is the person or entity engaged by the *Owner* and identified as such in the Agreement. The *Consultant* is the Architect, the Engineer or entity licensed to practise in the province or territory of the *Place of the Work.*

Contract

The *Contract* is the undertaking by the parties to perform their respective duties, responsibilities and obligations as prescribed in the *Contract Documents* and represents the entire agreement between the parties.

Contract Documents

The *Contract Documents* consist of those documents listed in Article A-3 of the Agreement – CONTRACT DOCUMENTS and amendments agreed upon between the parties.

Contract Price

The *Contract Price* is the amount stipulated in Article A-4 of the Agreement – CONTRACT PRICE.

Contract Time

The *Contract Time* is the time from commencement of the *Work* to the date of *Ready-for-Takeover* as stipulated in paragraph 1.3 of Article A-1 of the Agreement – THE WORK .

Contractor

The *Contractor* is the person or entity identified as such in the Agreement.

Drawings

The *Drawings* are the graphic and pictorial portions of the *Contract Documents*, wherever located and whenever issued, showing the design, location and dimensions of the *Work*, generally including plans, elevations, sections, details, and diagrams.

Notice in Writing

A *Notice in Writing*, where identified in the *Contract Documents*, is a written communication between the parties or between them and the *Consultant* that is transmitted in accordance with the provisions of Article A-6 of the Agreement – RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING.

Owner

The *Owner* is the person or entity identified as such in the Agreement.

Other Contractor

Other Contractor means a contractor, other than the *Contractor* or a *Subcontractor*, engaged by the *Owner* for the *Project*.

Payment Legislation

Payment Legislation means such legislation in effect at the *Place of the Work* which governs payment under construction contracts.

Place of the Work

The *Place of the Work* is the designated site or location of the *Work* identified in the *Contract Documents*.

Product

Product or Products means material, machinery, equipment, and fixtures forming part of the *Work*, but does not include *Construction Equipment.*

Project

The *Project* means the total construction contemplated of which the *Work* may be the whole or a part.

Ready-for-Takeover

Ready-for-Takeover shall have been attained when the conditions set out in paragraph 12.1.1 of GC 12.1 – READY-FOR-TAKEOVER have been met, as verified by the *Consultant* pursuant to paragraph 12.1.4.2 of GC 12.1 – READY-FOR-TAKEOVER.

Shop Drawings

Shop Drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures, *Product* data, and other data which the *Contractor* provides to illustrate details of portions of the *Work*.

Specifications

The *Specifications* are that portion of the *Contract Documents*, wherever located and whenever issued, consisting of the written requirements and standards for *Products*, systems, workmanship, quality, and the services necessary for the performance of the *Work*.

Subcontractor

A *Subcontractor* is a person or entity having a direct contract with the *Contractor* to perform a part or parts of the *Work* at the *Place of the Work*.

Substantial Performance of the Work

Substantial Performance of the Work is as defined in the lien legislation applicable to the *Place of the Work*.

Supplemental Instruction

A *Supplemental Instruction* is an instruction, not involving adjustment in the *Contract Price* or *Contract Time*, in the form of *Specifications*, *Drawings*, schedules, samples, models, or written instructions, consistent with the intent of the *Contract Documents*. It is to be issued by the *Consultant* to supplement the *Contract Documents* as required for the performance of the *Work*.

Supplier

A *Supplier* is a person or entity having a direct contract with the *Contractor* to supply *Products*.

Temporary Work

Temporary Work means temporary supports, structures, facilities, services, and other temporary items, excluding *Construction Equipment*, required for the execution of the *Work* but not incorporated into the *Work*.

Value Added Taxes

Value Added Taxes means such sum as shall be levied upon the *Contract Price* by the Federal or any Provincial or Territorial Government and is computed as a percentage of the *Contract Price* and includes the Goods and Services Tax, the Quebec Sales Tax, the Harmonized Sales Tax, and any similar tax, the collection and payment of which have been imposed on the *Contractor* by tax legislation.

Work

The *Work* means the total construction and related services required by the *Contract Documents*.

Working Day

Working Day means a day other than a Saturday, Sunday, statutory holiday, or statutory vacation day that is observed by the construction industry in the area of the *Place of the Work*.

GENERAL CONDITIONS

PART 1 GENERAL PROVISIONS

GC 1.1 CONTRACT DOCUMENTS

1.1.1 The intent of the *Contract Documents* is to include the labour, *Products* and services necessary for the performance of the *Work* by the *Contractor* in accordance with these documents. It is not intended, however, that the *Contractor* shall supply products or perform work not consistent with, not covered by, or not properly inferable from the *Contract Documents*.

1.1.2 The *Contract Documents* are complementary, and what is required by one shall be as binding as if required by all. Performance by the *Contractor* shall be required only to the extent consistent with the *Contract Documents*.

1.1.3 The *Contractor* shall review the *Contract Documents* for the purpose of facilitating co-ordination and execution of the *Work* by the *Contractor*.

1.1.4 The *Contractor* is not responsible for errors, omissions or inconsistencies in the *Contract Documents.* If there are perceived errors, omissions or inconsistencies discovered by or made known to the *Contractor*, the *Contractor* shall promptly report to the *Consultant* and shall not proceed with the work affected until the *Contractor* has received corrected or additional information from the *Consultant*.

1.1.5 If there is a conflict within the *Contract Documents*:

.1 the order of priority of documents, from highest to lowest, shall be

- the Agreement between *Owner* and *Contractor*,
- the Definitions,
- Supplementary Conditions,
- the General Conditions,
- Division 01 of the *Specifications*,
- technical *Specifications*,
- material and finishing schedules,
- the *Drawings*.

.2 *Drawings* of larger scale shall govern over those of smaller scale of the same date.

.3 dimensions shown on *Drawings* shall govern over dimensions scaled from *Drawings*.

.4 amended or later dated documents shall govern over earlier documents of the same type.

.5 noted materials and annotations shall govern over graphic indications.

1.1.6 Nothing contained in the *Contract Documents* shall create any contractual relationship between:

.1 the *Owner* and a *Subcontractor*, a *Supplier*, or their agent, employee, or other person performing any portion of the *Work*.

.2 the *Consultant* and the *Contractor*, a *Subcontractor*, a *Supplier*, or their agent, employee, or other person performing any portion of the *Work*.

1.1.7 Words and abbreviations which have well known technical or trade meanings are used in the *Contract Documents* in accordance with such recognized meanings.

1.1.8 References in the *Contract Documents* to the singular shall be considered to include the plural as the context requires.

1.1.9 Neither the organization of the *Specifications* nor the arrangement of *Drawings* shall control the *Contractor* in dividing the work among *Subcontractors* and *Suppliers*.

1.1.10 *Specifications*, *Drawings*, models, and copies thereof furnished by the *Consultant* are and shall remain the *Consultant*'s property, with the exception of the signed *Contract* sets, which shall belong to each party to the *Contract*. All *Specifications*, *Drawings* and models furnished by the *Consultant* are to be used only with respect to the *Work* and are not to be used on other work. These *Specifications*, *Drawings* and models are not to be copied or altered in any manner without the written authorization of the *Consultant*.

1.1.11 Physical models furnished by the *Contractor* at the *Owner*'s expense are the property of the *Owner*.

GC 1.2 LAW OF THE CONTRACT

1.2.1 The law of the *Place of the Work* shall govern the interpretation of the *Contract*.

GC 1.3 RIGHTS AND REMEDIES

1.3.1 Except as expressly provided in the *Contract Documents*, the duties and obligations imposed by the *Contract Documents* and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights, and remedies otherwise imposed or available by law.

1.3.2 No action or failure to act by the *Owner*, the *Consultant* or the *Contractor* shall constitute a waiver of any right or duty afforded any of them under the *Contract*, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

GC 1.4 ASSIGNMENT

1.4.1 Neither party to the *Contract* shall assign the *Contract* or a portion thereof without the written consent of the other, which consent shall not be unreasonably withheld.

PART 2 ADMINISTRATION OF THE CONTRACT

GC 2.1 AUTHORITY OF THE CONSULTANT

2.1.1 The *Consultant* will have authority to act on behalf of the *Owner* only to the extent provided in the *Contract Documents*, unless otherwise modified by written agreement as provided in paragraph 2.1.2.

2.1.2 The duties, responsibilities and limitations of authority of the *Consultant* as set forth in the *Contract Documents* shall be modified or extended only with the written consent of the *Owner*, the *Consultant* and the *Contractor*.

GC 2.2 ROLE OF THE CONSULTANT

2.2.1 The *Consultant* will provide administration of the *Contract* as described in the *Contract Documents*.

2.2.2 The *Consultant* will visit the *Place of the Work* at intervals appropriate to the progress of construction to become familiar with the progress and quality of the work and to determine if the *Work* is proceeding in general conformity with the *Contract Documents*.

2.2.3 If the *Owner* and the *Consultant* agree, the *Consultant* will provide at the *Place of the Work*, one or more project representatives to assist in carrying out the *Consultant*'s responsibilities. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in writing to the *Contractor*.

2.2.4 Based on the *Consultant*'s observations and evaluation of the *Contractor*'s applications for payment, the *Consultant* will determine the amounts owing to the *Contractor* under the *Contract* and will issue certificates for payment as provided in Article A-5 of the Agreement – PAYMENT, GC 5.3 – PAYMENT and GC 5.5 – FINAL PAYMENT.

2.2.5 The *Consultant* will not be responsible for and will not have control, charge or supervision of construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs required in connection with the *Work* in accordance with the applicable construction safety legislation, other regulations or general construction practice. The *Consultant* will not be responsible for the *Contractor*'s failure to perform the *Work* in accordance with the *Contract Documents*.

2.2.6 Except with respect to GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER, the *Consultant* will be, in the first instance, the interpreter of the requirements of the *Contract Documents*.

2.2.7 Matters in question relating to the performance of the *Work* or the interpretation of the *Contract Documents* shall be initially referred in writing to the *Consultant* by the party raising the question for interpretations and findings and copied to the other party.

2.2.8 Interpretations and findings of the *Consultant* shall be consistent with the intent of the *Contract Documents*. In making such interpretations and findings the *Consultant* will not show partiality to either the *Owner* or the *Contractor*.

2.2.9 The *Consultant*'s interpretations and findings will be given in writing to the parties within a reasonable time.

2.2.10 With respect to claims for a change in *Contract Price*, the *Consultant* will make findings as set out in GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE.

2.2.11 The *Consultant* will have authority to reject work which in the *Consultant*'s opinion does not conform to the requirements of the *Contract Documents*. Whenever the *Consultant* considers it necessary or advisable, the *Consultant* will have authority to require inspection or testing of work, whether or not such work is fabricated, installed or completed. However, neither the authority of the *Consultant* to act nor any decision either to exercise or not to exercise such authority shall give rise to any duty or responsibility of the *Consultant* to the *Contractor*, *Subcontractors*, *Suppliers*, or their agents, employees, or other persons performing any of the *Work*.

2.2.12 During the progress of the *Work* the *Consultant* will furnish *Supplemental Instructions* to the *Contractor* with reasonable promptness or in accordance with a schedule for such instructions agreed to by the *Consultant* and the *Contractor*.

2.2.13 The *Consultant* will review and take appropriate action upon *Shop Drawings*, samples and other submittals by the *Contractor*, in accordance with the *Contract Documents*.

2.2.14 The *Consultant* will prepare *Change Orders* and *Change Directives* as provided in GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.

2.2.15 The *Consultant* will conduct reviews of the *Work* to determine the date of *Substantial Performance of the Work* and verify that *Ready-for-Takeover* has been attained.

2.2.16 All certificates issued by the *Consultant* will be to the best of the *Consultant*'s knowledge, information and belief. By issuing any certificate, the *Consultant* does not guarantee the *Work* is correct or complete.

2.2.17 The *Consultant* will receive and review written warranties and related documents required by the *Contract* and provided by the *Contractor* and will forward such warranties and documents to the *Owner* for the *Owner*'s acceptance.

2..2.18 If the *Consultant*'s engagement is terminated, the *Owner* shall immediately engage a *Consultant* against whom the *Contractor* makes no reasonable objection and whose duties and responsibilities under the *Contract Documents* will be that of the former *Consultant*.

GC 2.3 REVIEW AND INSPECTION OF THE WORK

2.3.1 The *Owner* and the *Consultant* shall have access to the *Work* at all times. The *Contractor* shall provide sufficient, safe and proper facilities at all times for the review of the *Work* by the *Consultant* and the inspection of the *Work* by authorized agencies. If parts of the *Work* are in preparation at locations other than the *Place of the Work*, the *Owner* and the *Consultant* shall be given access to such work whenever it is in progress.

2.3.2 If work is designated for tests, inspections or approvals in the *Contract Documents*, by the *Consultant*'s instructions, or by the laws or ordinances of the *Place of the Work*, the *Contractor* shall give the *Consultant* reasonable notification of when the work will be ready for review and inspection. The *Contractor* shall arrange for and shall give the *Consultant* reasonable notification of the date and time of inspections by other authorities.

2.3.3 The *Contractor* shall furnish promptly to the *Consultant* two copies of certificates and inspection reports relating to the *Work*.

2.3.4 If the *Contractor* covers, or permits to be covered, work that has been designated for special tests, inspections or approvals before such special tests, inspections or approvals are made, given or completed, the *Contractor* shall, if so directed, uncover such work, have the inspections or tests satisfactorily completed, and make good covering work at the *Contractor*'s expense.

2.3.5 The *Consultant* may order any portion or portions of the *Work* to be examined to confirm that such work is in accordance with the requirements of the *Contract Documents*. If the work is not in accordance with the requirements of the *Contract Documents*, the *Contractor* shall correct the work and pay the cost of examination and correction. If the work is in accordance with the requirements of the *Contract Documents*, the *Owner* shall pay the cost of examination and restoration.

2.3.6 The *Contractor* shall pay the cost of making any test or inspection, including the cost of samples required for such test or inspection, if such test or inspection is designated in the *Contract Documents* to be performed by the *Contractor* or is required by the laws or ordinances applicable to the *Place of the Work*.

2.3.7 The *Contractor* shall pay the cost of samples required for any test or inspection to be performed by others if such test or inspection is designated in the *Contract Documents*.

GC 2.4 DEFECTIVE WORK

2.4.1 The *Contractor* shall promptly correct defective work that has been rejected by the *Consultant* as failing to conform to the *Contract Documents* whether or not the defective work was incorporated in the *Work* or the defect is the result of poor workmanship, use of defective products or damage through carelessness or other act or omission of the *Contractor*.

2.4.2 The *Contractor* shall make good promptly *Other Contractors'* work destroyed or damaged by such corrections at the *Contractor*'s expense.

2.4.3 If in the opinion of the *Consultant* it is not expedient to correct defective work or work not performed as provided in the *Contract Documents*, the *Owner* may deduct from the amount otherwise due to the *Contractor* the difference in value between the work as performed and that called for by the *Contract Documents*. If the *Owner* and the *Contractor* do not agree on the difference in value, they shall refer the matter to the *Consultant* for a finding.

PART 3 EXECUTION OF THE WORK

GC 3.1 CONTROL OF THE WORK

3.1.1 The *Contractor* shall have total control of the *Work* and shall effectively direct and supervise the *Work* so as to ensure conformity with the *Contract Documents*.

3.1.2 The *Contractor* shall be solely responsible for construction means, methods, techniques, sequences, and procedures and for co-ordinating the various parts of the *Work* under the *Contract*.

GC 3.2 CONSTRUCTION BY THE OWNER OR OTHER CONTRACTORS

3.2.1 The *Owner* reserves the right to award separate contracts in connection with other parts of the *Project* to *Other Contractors* and to perform work with own forces.

3.2.2 When separate contracts are awarded for other parts of the *Project*, or when work is performed by the *Owner*'s own forces, the *Owner* shall:

.1 provide for the co-ordination of the activities and work of *Other Contractors* and the *Owner*'s own forces with the *Work* of the *Contract*;

.2 enter into separate contracts with *Other Contractors* under conditions of contract which are compatible with the conditions of the *Contract*;

.3 ensure that insurance coverage is provided to the same requirements as are called for in GC 11.1 – INSURANCE and co-ordinate such insurance with the insurance coverage of the *Contractor* as it affects the *Work*; and

.4 take all reasonable precautions to avoid labour disputes or other disputes on the *Project* arising from the work of *Other Contractors* or the *Owner*'s own forces.

3.2.3 When separate contracts are awarded for other parts of the *Project*, or when work is performed by the *Owner*'s own forces, the *Contractor* shall:

.1 afford the *Owner* and *Other Contractors* reasonable opportunity to store their products and execute their work;

.2 co-ordinate and schedule the *Work* with the work of *Other Contractors* or the *Owner*'s own forces that are identified in the *Contract Documents*;

.3 participate with *Other Contractors* and the *Owner* in reviewing their construction schedules when directed to do so; and

.4 report promptly to the *Consultant* in writing any apparent deficiencies in the work of *Other Contractors* or of the *Owner*'s own forces, where such work affects the proper execution of any portion of the *Work*, prior to proceeding with that portion of the *Work*.

3.2.4 Where a change in the *Work* is required as a result of the co-ordination and integration of the work of *Other Contractors* or *Owner*'s own forces with the *Work*, the changes shall be authorized and valued as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.

3.2.5 Disputes and other matters in question between the *Contractor* and *Other Contractors* shall be dealt with as provided in Part 8 of the General Conditions – DISPUTE RESOLUTION provided the *Other Contractors* have reciprocal obligations. The *Contractor* shall be deemed to have consented to arbitration of any dispute with any *Other Contractor* whose contract with the *Owner* contains a similar agreement to arbitrate. In the absence of *Other Contractors* having reciprocal obligations, disputes and other matters in question initiated by the *Contractor* against *Other Contractors* will be considered disputes and other matters in question between the *Contractor* and the *Owner*.

3.2.6 Should the *Owner*, the *Consultant*, *Other Contractors*, or anyone employed by them directly or indirectly be responsible for ill-timed work necessitating cutting or remedial work to be performed, the cost of such cutting or remedial work shall be valued as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.

GC 3.3 TEMPORARY WORK

3.3.1 The *Contractor* shall have the sole responsibility for the design, erection, operation, maintenance, and removal of *Temporary Work* unless otherwise specified in the *Contract Documents*.

3.3.2 The *Contractor* shall engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform those functions referred to in paragraph 3.3.1 where required by law or by the *Contract Documents* and in all cases where such *Temporary Work* is of such a nature that professional engineering skill is required to produce safe and satisfactory results.

3.3.3 Notwithstanding the provisions of GC 3.1 – CONTROL OF THE WORK, paragraphs 3.3.1 and 3.3.2 or provisions to the contrary elsewhere in the *Contract Documents* where such *Contract Documents* include designs for *Temporary Work* or specify a method of construction in whole or in part, such designs or methods of construction shall be considered to be part of the design of the *Work* and the *Contractor* shall not be held responsible for that part of the design or the specified method of construction. The *Contractor* shall, however, be responsible for the execution of such design or specified method of construction in the same manner as for the execution of the *Work*.

GC 3.4 CONSTRUCTION SCHEDULE

3.4.1 The *Contractor* shall:

.1 prepare and submit to the *Owner* and the *Consultant* prior to the first application for payment, a construction schedule that indicates the timing of the major activities of the *Work* and provides sufficient detail of the critical events and their inter-relationship to demonstrate the *Work* will be performed in conformity with the *Contract Time*;

.2 monitor the progress of the *Work* relative to the construction schedule and update the schedule on a monthly basis or as stipulated by the *Contract Documents*; and

.3 advise the *Consultant* of any revisions required to the schedule as the result of extensions of the *Contract Time* as provided in Part 6 of the General Conditions – CHANGES IN THE WORK.

GC 3.5 SUPERVISION

3.5.1 The *Contractor* shall provide all necessary supervision and appoint a competent representative who shall be in attendance at the *Place of the Work* while the *Work* is being performed. The appointed representative shall not be changed except for valid reason.

3.5.2 The appointed representative shall represent the *Contractor* at the *Place of the Work*. Information and instructions provided by the *Consultant* to the *Contractor*'s appointed representative shall be deemed to have been received by the *Contractor*, except with respect to Article A-6 of the Agreement – RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING.

GC 3.6 SUBCONTRACTORS AND SUPPLIERS

3.6.1 The *Contractor* shall preserve and protect the rights of the parties under the *Contract* with respect to work to be performed under subcontract, and shall:

.1 enter into contracts or written agreements with *Subcontractors* and *Suppliers* to require them to perform their work as provided in the *Contract Documents*;

.2 incorporate the applicable terms and conditions of the *Contract Documents* into all contracts or written agreements with *Subcontractors* and *Suppliers*; and

.3 be as fully responsible to the *Owner* for acts and omissions of *Subcontractors*, *Suppliers* and any persons directly or indirectly employed by them as for acts and omissions of persons directly employed by the *Contractor*.

3.6.2 The *Contractor* shall indicate in writing, if requested by the *Owner*, those *Subcontractors* or *Suppliers* whose bids have been received by the *Contractor* which the *Contractor* would be prepared to accept for the performance of a portion of the *Work*. Should the *Owner* not object before signing the *Contract*, the *Contractor* shall employ those *Subcontractors* or *Suppliers* so identified by the *Contractor* in writing for the performance of that portion of the *Work* to which their bid applies.

3.6.3 The *Owner* may, for reasonable cause, at any time before the *Owner* has signed the *Contract*, object to the use of a proposed *Subcontractor* or *Supplier* and require the *Contractor* to employ one of the other subcontract bidders.

3.6.4 If the *Owner* requires the *Contractor* to change a proposed *Subcontractor* or *Supplier*, the *Contract Price* and *Contract Time* shall be adjusted by the difference occasioned by such required change.

3.6.5 The *Contractor* shall not be required to employ as a *Subcontractor* or *Supplier*, a person or firm to which the *Contractor* may reasonably object.

3.6.6 The *Owner*, through the *Consultant*, may provide to a *Subcontractor* or *Supplier* information as to the percentage of the *Subcontractor*'s or *Supplier*'s work which has been certified for payment.

GC 3.7 LABOUR AND PRODUCTS

3.7.1 The *Contractor* shall maintain good order and discipline among the *Contractor*'s employees engaged on the *Work* and employ only workers that are skilled in the tasks assigned.

3.7.2 The *Contractor* shall provide and pay for labour, *Products*, tools, *Construction Equipment*, water, heat, light, power, transportation, and other facilities and services necessary for the performance of the *Work* in accordance with the *Contract*.

3.7.3 Unless otherwise specified in the *Contract Documents*, *Products* provided shall be new. *Products* which are not specified shall be of a quality consistent with those specified and their use acceptable to the *Consultant*.

GC 3.8 SHOP DRAWINGS

3.8.1 The *Contractor* shall provide *Shop Drawings* as required in the *Contract Documents*.

3.8.2 The *Contractor* shall provide *Shop Drawings* to the *Consultant* to review in accordance with an agreed schedule, or in the absence of an agreed schedule, in orderly sequence and sufficiently in advance so as to cause no delay in the *Work* or in the work of *Other Contractors* or the *Owner*'s own forces.

3.8.3 The *Contractor* shall review all *Shop Drawings* before providing them to the *Consultant*. The *Contractor* represents by this review that:

.1 the *Contractor* has determined and verified all applicable field measurements, field construction conditions, *Product* requirements, catalogue numbers and similar data, or will do so, and

.2 the *Contractor* has checked and co-ordinated each *Shop Drawing* with the requirements of the *Work* and of the *Contract Documents*.

3.8.4 The *Consultant*'s review is for conformity to the design concept and for general arrangement only.

3.8.5 At the time of providing *Shop Drawings*, the *Contractor* shall expressly advise the *Consultant* in writing of any deviations in a *Shop Drawing* from the requirements of the *Contract Documents.* The *Consultant* shall indicate the acceptance or rejection of such deviation expressly in writing.

3.8.6 The *Consultant*'s review shall not relieve the *Contractor* of responsibility for errors or omissions in the *Shop Drawings* or for meeting all requirements of the *Contract Documents*.

3.8.7 The *Consultant* will review and return *Shop Drawings* in accordance with the schedule agreed upon, or, in the absence of such schedule, with reasonable promptness so as to cause no delay in the performance of the *Work*.

PART 4 ALLOWANCES

GC 4.1 CASH ALLOWANCES

4.1.1 The *Contract Price* includes the cash allowances, if any, stated in the *Contract Documents*. The scope of the *Work* or costs included in such cash allowances shall be as described in the *Contract Documents*.

4.1.2 The *Contract Price*, and not the cash allowances, includes the *Contractor*'s overhead and profit in connection with such cash allowances.

4.1.3 Expenditures under cash allowances shall be authorized by the *Owner* through the *Consultant*.

4.1.4 Where the actual cost of the *Work* under any cash allowance exceeds the amount of the allowance, any unexpended amounts from other cash allowances shall be reallocated, at the *Consultant's* direction, to cover the shortfall, and, in that case, there shall be no additional amount added to the *Contract Price* for overhead and profit. Only where the actual cost of the *Work* under all cash allowances exceeds the total amount of all cash allowances shall the *Contractor* be compensated for the excess incurred and substantiated, plus an amount for overhead and profit on the excess only, as set out in the *Contract Documents*.

4.1.5 The net amount of any unexpended cash allowances, after providing for any reallocations as contemplated in paragraph 4.1.4, shall be deducted from the *Contract Price* by *Change Order* without any adjustment for the *Contractor's* overhead and profit on such amount.

4.1.6 The value of the *Work* performed under a cash allowance is eligible to be included in progress payments.

4.1.7 The *Contractor* and the *Consultant* shall jointly prepare a schedule that shows when the items called for under cash allowances must be ordered to avoid delaying the progress of the *Work*.

GC 4.2 CONTINGENCY ALLOWANCE

4.2.1 The *Contract Price* includes the contingency allowance, if any, stated in the *Contract Documents*.

4.2.2 The contingency allowance includes the *Contractor*'s overhead and profit in connection with such contingency allowance.

4.2.3 Expenditures under the contingency allowance shall be authorized and valued as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.

4.2.4 The *Contract Price* shall be adjusted by *Change Order* to provide for any difference between the expenditures authorized under paragraph 4.2.3 and the contingency allowance.

PART 5 PAYMENT

GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

5.1.1 The *Owner* shall, at the request of the *Contractor*, before signing the *Contract*, and promptly from time to time thereafter, furnish to the *Contractor* reasonable evidence that financial arrangements have been made to fulfill the *Owner*'s obligations under the *Contract*.

5.1.2 The *Owner* shall give the *Contractor Notice in Writing* of any material change in the *Owner*'s financial arrangements to fulfil the *Owner*'s obligations under the *Contract* during the performance of the *Contract*.

GC 5.2 APPLICATIONS FOR PAYMENT

5.2.1 Applications for payment on account as provided in Article A-5 of the Agreement – PAYMENT shall be submitted monthly to the *Owner* and the *Consultant* simultaneously as the *Work* progresses.

5.2.2 Applications for payment shall be dated the last day of each payment period, which is the last day of the month or an alternative day of the month agreed in writing by the parties.

5.2.3 The amount claimed shall be for the value, proportionate to the amount of the *Contract*, of *Work* performed and *Products* delivered to the *Place of the Work* as of the last day of the payment period.

5.2.4 The *Contractor* shall submit to the *Consultant*, at least 15 calendar days before the first application for payment, a schedule of values for the parts of the *Work*, aggregating the total amount of the *Contract Price*, so as to facilitate evaluation of applications for payment.

5.2.5 The schedule of values shall be made out in such form as specified in the *Contract* and supported by such evidence as the *Consultant* may reasonably require.

5.2.6 Applications for payment shall be based on the schedule of values accepted by the *Consultant* and shall comply with the provisions of *Payment Legislation*.

5.2.7 Each application for payment shall include evidence of compliance with workers' compensation legislation at the *Place of the Work* and after the first payment, a declaration by the *Contractor* as to the distribution made of the amounts previously received using document CCDC 9A 'Statutory Declaration'.

5.2.8 Applications for payment for *Products* delivered to the *Place of the Work* but not yet incorporated into the *Work* shall be supported by such evidence as the *Consultant* may reasonably require to establish the value and delivery of the *Products*.

GC 5.3 PAYMENT

5.3.1 After receipt by the *Consultant* and the *Owner* of an application for payment submitted by the *Contractor* in accordance with GC 5.2 – APPLICATIONS FOR PAYMENT:

.1 The *Consultant* will issue to the *Owner* and copy to the *Contractor*, no later than 10 calendar days after the receipt of the application for payment, a certificate for payment in the amount applied for, or in such other amount as the *Consultant* determines to be properly due. If the *Consultant* certifies a different amount, or rejects the application or part thereof, the *Owner* shall promptly issue a written notice to the *Contractor* giving reasons for the revision or rejection, such written notice to be in compliance with *Payment Legislation*.

.2 The *Owner* shall make payment to the *Contractor* on account as provided in Article A-5 of the Agreement – PAYMENT on or before 28 calendar days after the receipt by the *Owner* and the *Consultant* of the application for payment, and in any event, in compliance with *Payment Legislation*.

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

5.4.1 The *Consultant* will review the *Work* to certify or verify the validity of the application for *Substantial Performance of the Work* and will promptly, and in any event, no later than 20 calendar days after receipt of the *Contractor*s application:

.1 advise the *Contractor* in writing that the *Work* or the designated portion of the *Work* is not substantially performed and give reasons why, or

.2 state the date of *Substantial Performance of the Work* or a designated portion of the *Work* in a certificate and issue a copy of that certificate to each of the *Owner* and the *Contractor*.

5.4.2 Where the holdback amount required by the applicable lien legislation has not been placed in a separate lien holdback account, the *Owner* shall, no later than 10 calendar days prior to the expiry of the holdback period stipulated in the lien legislation applicable to the *Place of the Work*, place the holdback amount in a bank account in the joint names of the *Owner* and the *Contractor*.

5.4.3 Subject to the requirements of any *Payment Legislation*, all holdback amount prescribed by the applicable lien legislation for the *Work* shall become due and payable to the *Contractor* no later than 10 *Working Days* following the expiration of the holdback period stipulated in the lien legislation applicable to the *Place of the Work*.

5.4.4 The *Contractor* shall submit an application for payment of the lien holdback amount in accordance with GC 5.3 – PAYMENT.

5.4.5 Where legislation permits progressive release of the holdback for a portion of the *Work* and the *Consultant* has certified or verified that the part of the *Work* has been performed prior to *Substantial Performance of the Work*, the *Owner* hereby agrees to release, and shall release, such portion to the *Contractor* in accordance with such legislation.

5.4.6 Notwithstanding any progressive release of the holdback, the *Contractor* shall ensure that such parts of the *Work* are protected pending the issuance of a final certificate for payment and be responsible for the correction of defects or work not performed regardless of whether or not such was apparent when the holdback was released.

GC 5.5 FINAL PAYMENT

5.5.1 When the *Contractor* considers that the *Work* is completed, the *Contractor* shall submit an application for final payment.

5.5.2 The *Consultant* will, no later than 10 calendar days after the receipt of an application from the *Contractor* for final payment, review the *Work* to verify the validity of the application and when the *Consultant* finds the *Contractor*'s application for final payment valid, the *Consultant* will promptly issue a final certificate for payment to the *Owner,* with a copy to the *Contractor*.

5.5.3 If the *Consultant* rejects the application or part thereof, the *Owner* will promptly issue a written notice to the *Contractor* giving reasons for the revision or rejection, such written notice to be in compliance with *Payment Legislation.*

5.5.4 Subject to the provision of paragraph 10.4.1 of GC 10.4 – WORKERS' COMPENSATION, and any legislation applicable to the *Place of the Work,* the *Owner* shall, no later than 5 calendar days after the issuance of a final certificate for payment, pay the *Contractor* as provided in Article A-5 of the Agreement – PAYMENT and in any event, in compliance with *Payment Legislation*.

GC 5.6 DEFERRED WORK

5.6.1 If because of climatic or other conditions reasonably beyond the control of the *Contractor*, or if the *Owner* and the *Contractor* agree that, there are items of work that must be deferred, payment in full for that portion of the *Work* which has been performed as certified by the *Consultant* shall not be withheld or delayed by the *Owner* on account thereof, but the *Owner* may withhold, until the remaining portion of the *Work* is finished, only such an amount that the *Consultant* determines is sufficient and reasonable to cover the cost of performing such deferred *Work*.

GC 5.7 NON-CONFORMING WORK

5.7.1 No payment by the *Owner* under the *Contract* nor partial or entire use or occupancy of the *Work* by the *Owner* shall constitute an acceptance of any portion of the *Work* or *Products* which are not in accordance with the requirements of the *Contract Documents.*

PART 6 CHANGES IN THE WORK

GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

6.1.1 The *Owner*, through the *Consultant*, without invalidating the *Contract*, may make:
- .1 changes in the *Work* consisting of additions, deletions or other revisions to the *Work* by *Change Order* or *Change Directive*, and
- .2 changes to the *Contract Time* for the *Work*, or any part thereof, by *Change Order*.

6.1.2 The *Contractor* shall not perform a change in the *Work* without a *Change Order* or a *Change Directive*.

GC 6.2 CHANGE ORDER

6.2.1 When a change in the *Work* is proposed or required, the *Consultant* will provide the *Contractor* with a written description of the proposed change in the *Work*. The *Contractor* shall promptly present to the *Consultant*, in a form that can be reasonably evaluated, a method of adjustment or an amount of adjustment for the *Contract Price*, if any, and the adjustment in the *Contract Time*, if any, for the proposed change in the *Work*.

6.2.2 When the *Owner* and the *Contractor* agree to the adjustments in the *Contract Price* and *Contract Time* or to the method to be used to determine the adjustments, such agreement shall be effective immediately and shall be recorded in a *Change Order*. The value of the work performed as the result of a *Change Order* shall be included in the applications for progress payment.

GC 6.3 CHANGE DIRECTIVE

6.3.1 If the *Owner* requires the *Contractor* to proceed with a change in the *Work* prior to the *Owner* and the *Contractor* agreeing upon the corresponding adjustment in *Contract Price* and *Contract Time*, the *Owner*, through the *Consultant*, shall issue a *Change Directive*.

6.3.2 A *Change Directive* shall only be used to direct a change in the *Work* which is within the general scope of the *Contract Documents*.

6.3.3 A *Change Directive* shall not be used to direct a change in the *Contract Time* only.

6.3.4 Upon receipt of a *Change Directive*, the *Contractor* shall proceed promptly with the change in the *Work*.

6.3.5 For the purpose of valuing *Change Directives*, changes in the *Work* that are not substitutions or otherwise related to each other shall not be grouped together in the same *Change Directive*.

6.3.6 The adjustment in the *Contract Price* for a change carried out by way of a *Change Directive* shall be determined on the basis of the cost of the *Contractor*'s actual expenditures and savings attributable to the *Change Directive*, valued in accordance with paragraph 6.3.7 and as follows:

.1 If the change results in a net increase in the *Contractor*'s cost, the *Contract Price* shall be increased by the amount of the net increase in the *Contractor*'s cost, plus the *Contractor*'s percentage fee on such net increase.

.2 If the change results in a net decrease in the *Contractor*'s cost, the *Contract Price* shall be decreased by the amount of the net decrease in the *Contractor*'s cost, without adjustment for the *Contractor*'s percentage fee.

.3 The *Contractor*'s fee shall be as specified in the *Contract Documents* or as otherwise agreed by the parties.

6.3.7 The cost of performing the work attributable to the *Change Directive* shall be limited to the actual cost of the following in as much as it contributes directly to the implementation of the *Change Directive*:

Labour

.1 rates that are listed in the schedule or as agreed by the *Owner* and the *Contractor* including wages, benefits, compensation, contributions, assessments, or taxes incurred for such items as employment insurance, provincial or territorial health insurance, workers' compensation, and Canada or Quebec Pension Plan for:

(1) trade labour in the direct employ of the *Contractor*;

(2) the *Contractor*'s personnel when stationed at the field office;

(3) the *Contractor*'s personnel engaged at shops or on the road, in expediting the production or transportation of materials or equipment; and

(4) the *Contractor*'s office personnel engaged in a technical capacity, or other personnel identified in Article A-3 of the Agreement – CONTRACT DOCUMENTS for the time spent in the performance of the *Work*;

Products, Construction Equipment and Temporary Work

.2 cost of all *Products* including cost of transportation thereof;

.3 in the absence of agreed rates, cost less salvage value of *Construction Equipment*, *Temporary Work* and tools, exclusive of hand tools under $1,000 owned by the *Contractor*;

.4 rental cost of *Construction Equipment*, *Temporary Work* and tools, exclusive of hand tools under $1,000;

.5 cost of all equipment and services required for the *Contractor*'s field office;

Subcontract

.6 subcontract amounts of Subcontractor with pricing mechanism approved by the *Owner*;

Others

.7 travel and subsistence expenses of the *Contractor*'s personnel described in paragraph 6.3.7.1;

.8 deposits lost provided that they are not caused by negligent acts or omissions of the *Contractor*;

.9 cost of quality assurance such as independent inspection and testing services;

.10 charges levied by authorities having jurisdiction at the *Place of the Work*;

.11 royalties, patent license fees, and damages for infringement of patents and cost of defending suits therefor subject always to the *Contractor*'s obligations to indemnify the *Owner* as provided in paragraph 10.3.1 of GC 10.3 – PATENT FEES;

.12 premium for all contract securities and insurance for which the *Contractor* is required, by the *Contract Documents*, to provide, maintain and pay in relation to the performance of the *Work*;

.13 losses and expenses sustained by the *Contractor* for matters which are the subject of insurance under the policies prescribed in GC 11.1 – INSURANCE when such losses and expenses are not recoverable because the amounts are in excess of collectible amounts or within the deductible amounts;

.14 taxes and duties, other than *Value Added Taxes*, income, capital, or property taxes, relating to the *Work* for which the *Contractor* is liable;

.15 charges for voice and data communications, courier services, expressage, transmittal and reproduction of documents, and petty cash items;

.16 cost for removal and disposal of waste products and debris;

.17 legal costs, incurred by the *Contractor*, in relation to the performance of the *Work* provided that they are not:

(1) relating to a dispute between the *Owner* and the *Contractor* unless such costs are part of a settlement or awarded by arbitration or court,

(2) the result of the negligent acts or omissions of the *Contractor*, or

(3) the result of a breach of this *Contract* by the *Contractor*;

.18 cost of auditing when requested by the *Owner*; and

.19 cost of *Project* specific information technology in accordance with the method determined by the parties.

6.3.8 Notwithstanding any other provisions contained in the General Conditions of the *Contract*, it is the intention of the parties that the cost of any item under any cost element referred to in paragraph 6.3.7 shall cover and include any and all costs or liabilities attributable to the *Change Directive* other than those which are the result of or occasioned by any failure on the part of the *Contractor* to exercise reasonable care and diligence in the *Contractor*'s attention to the *Work*. Any cost due to failure on the part of the *Contractor* to exercise reasonable care and diligence in the *Contractor*'s performance of the *Work* attributable to the *Change Directive* shall be borne by the *Contractor*.

6.3.9 The *Contractor* shall keep full and detailed accounts and records necessary for the documentation of the cost of performing the *Work* attributable to the *Change Directive* and shall provide the *Consultant* with copies thereof.

6.3.10 For the purpose of valuing *Change Directives*, the *Owner* shall be afforded reasonable access to all of the *Contractor*'s pertinent documents related to the cost of performing the *Work* attributable to the *Change Directive*.

6.3.11 Pending determination of the final amount of a *Change Directive*, the undisputed value of the *Work* performed as the result of a *Change Directive* is eligible to be included in progress payments.

6.3.12 If the *Owner* and the *Contractor* do not agree on the proposed adjustment in the *Contract Time* attributable to the change in the *Work*, or the method of determining it, the adjustment shall be referred to the *Consultant* for a finding.

6.3.13 When the *Owner* and the *Contractor* reach agreement on the adjustment to the *Contract Price* and to the *Contract Time*, this agreement shall be recorded in a *Change Order*.

GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

6.4.1 If the *Owner* or the *Contractor* discover conditions at the *Place of the Work* which are:

.1 subsurface or otherwise concealed physical conditions which existed before the commencement of the *Work* and differ materially from those indicated in the *Contract Documents*; or

.2 physical conditions, other than conditions due to weather, that are of a nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the *Contract Documents*,

then the observing party shall give *Notice in Writing* to the other party of such conditions before they are disturbed and in no event later than 5 *Working Days* after first observance of the conditions.

6.4.2 The *Consultant* will promptly investigate such conditions and make a finding. If the finding is that the conditions differ materially and this would cause an increase or decrease in the *Contractor*'s cost or time to perform the *Work*, the *Owner*, through the *Consultant*, shall issue appropriate instructions for a change in the *Work* as provided in GC 6.2 – CHANGE ORDER or GC 6.3 – CHANGE DIRECTIVE.

6.4.3 If the *Consultant* finds that the conditions at the *Place of the Work* are not materially different or that no change in the *Contract Price* or the *Contract Time* is justified, the *Consultant* will promptly inform the *Owner* and the *Contractor* in writing.

6.4.4 If such concealed or unknown conditions relate to toxic and hazardous substances and materials, artifacts and fossils, or mould, the parties will be governed by the provisions of GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES, GC 9.3 – ARTIFACTS AND FOSSILS and GC 9.5 – MOULD.

GC 6.5 DELAYS

6.5.1 If the *Contractor* is delayed in the performance of the *Work* by the *Owner*, the *Consultant*, or anyone employed or engaged by them directly or indirectly, contrary to the provisions of the *Contract Documents*, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The *Contractor* shall be reimbursed by the *Owner* for reasonable costs incurred by the *Contractor* as the result of such delay.

6.5.2 If the *Contractor* is delayed in the performance of the *Work* by a stop work order issued by a court or other public authority and providing that such order was not issued as the result of an act or fault of the *Contractor* or any person employed or engaged by the *Contractor* directly or indirectly, resulting in the failure of the *Contractor* to attain *Ready-for-Takeover* by the date stipulated in Article A-1 of the Agreement – THE WORK, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The *Contractor* shall be reimbursed by the *Owner* for reasonable costs incurred by the *Contractor* as the result of such delay.

6.5.3 If the *Contractor* is delayed in the performance of the *Work* by:

.1 labour disputes, strikes, lock-outs (including lock-outs decreed or recommended for its members by a recognized contractors' association, of which the *Contractor* is a member or to which the *Contractor* is otherwise bound),

.2 fire, unusual delay by common carriers or unavoidable casualties,

.3 abnormally adverse weather conditions, or

.4 any cause beyond the *Contractor*'s control other than one resulting from a default or breach of *Contract* by the *Contractor*, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The extension of time shall not be less than the time lost as the result of the event causing the delay, unless the *Contractor* agrees to a shorter extension. The *Contractor* shall not be entitled to payment for costs incurred by such delays unless such delays result from actions by the *Owner*, the *Consultant* or anyone employed or engaged by them directly or indirectly.

6.5.4 No extension shall be made for delay unless *Notice in Writing* of the cause of delay is given to the *Consultant* not later than 10 *Working Days* after the commencement of the delay. In the case of a continuing cause of delay only one *Notice in Writing* shall be necessary.

6.5.5 If no schedule is made under paragraph 2.2.12 of GC 2.2 – ROLE OF THE CONSULTANT, then no request for extension shall be made because of failure of the *Consultant* to furnish instructions until 10 *Working Days* after demand for such instructions has been made.

GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE

6.6.1 If the *Contractor* intends to make a claim for an increase to the *Contract Price*, or if the *Owner* intends to make a claim against the *Contractor* for a credit to the *Contract Price*, the party that intends to make the claim shall give timely *Notice in Writing* of intent to claim to the other party and to the *Consultant*.

6.6.2 Upon commencement of the event or series of events giving rise to a claim, the party intending to make the claim shall:
.1 take all reasonable measures to mitigate any loss or expense which may be incurred as a result of such event or series of events, and
.2 keep such records as may be necessary to support the claim.

6.6.3 The party making the claim shall submit within a reasonable time to the *Consultant* a detailed account of the amount claimed and the grounds upon which the claim is based and the *Consultant* will make a finding upon such claim.

6.6.4 Where the event or series of events giving rise to the claim has a continuing effect, the detailed account submitted under paragraph 6.6.3 shall be considered to be an interim account and the party making the claim shall, at such intervals as the *Consultant* may reasonably require, submit further interim accounts giving the accumulated amount of the claim and any further grounds upon which it is based. The party making the claim shall submit a final account after the end of the effects resulting from the event or series of events.

6.6.5 The *Consultant's* findings, with respect to a claim made by either party, will be given by *Notice in Writing* to both parties within 30 *Working Days* after receipt of the claim by the *Consultant*, or within such other time period as may be agreed by the parties.

6.6.6 If such finding is not acceptable to either party, the claim shall be settled in accordance with Part 8 of the General Conditions – DISPUTE RESOLUTION.

PART 7 DEFAULT NOTICE

GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

7.1.1 If the *Contractor* is adjudged bankrupt, or makes a general assignment for the benefit of creditors because of the *Contractor*'s insolvency, or if a receiver is appointed because of the *Contractor*'s insolvency, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, terminate the *Contractor*'s right to continue with the *Work*, by giving the *Contractor* or receiver or trustee in bankruptcy *Notice in Writing* to that effect.

7.1.2 If the *Contractor* neglects to perform the *Work* properly or otherwise fails to comply with the requirements of the *Contract* to a substantial degree and if the *Consultant* has given a written statement to the *Owner* and *Contractor* which provides the detail of such neglect to perform the *Work* properly or such failure to comply with the requirements of the *Contract* to a substantial degree, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, give the *Contractor Notice in Writing*, containing particulars of the default including references to applicable provisions of the *Contract*, that the *Contractor* is in default of the *Contractor*'s contractual obligations and instruct the *Contractor* to correct the default in the 5 *Working Days* immediately following the receipt of such *Notice in Writing*.

7.1.3 If the default cannot be corrected in the 5 *Working Days* specified or in such other time period as may be subsequently agreed in writing by the parties, the *Contractor* shall be in compliance with the *Owner*'s instructions if the *Contractor*:
.1 commences the correction of the default within the specified time,
.2 provides the *Owner* with an acceptable schedule for such correction, and
.3 corrects the default in accordance with the *Contract* terms and with such schedule.

7.1.4 If the *Contractor* fails to correct the default in the time specified or in such other time period as may be subsequently agreed in writing by the parties, without prejudice to any other right or remedy the *Owner* may have, the *Owner* may by giving *Notice in Writing*:

.1 correct such default and deduct the cost thereof from any payment then or thereafter due the *Contractor* for the *Work* provided the *Consultant* has certified such cost to the *Owner* and the *Contractor*, or

.2 terminate the *Contractor*'s right to continue with the *Work* in whole or in part or terminate the *Contract*.

7.1.5 If the *Owner* terminates the *Contractor*'s right to continue with the *Work* as provided in paragraphs 7.1.1 and 7.1.4, the *Owner* shall be entitled to:

.1 take possession of the *Work* and *Products* at the *Place of the Work*; subject to the rights of third parties, utilize the *Construction Equipment* at the *Place of the Work*; finish the *Work* by whatever method the *Owner* may consider expedient, but without undue delay or expense,

.2 withhold further payment to the *Contractor* until a final certificate for payment is issued,

.3 charge the *Contractor* the amount by which the full cost of finishing the *Work* as certified by the *Consultant*, including compensation to the *Consultant* for the *Consultant*'s additional services and a reasonable allowance as determined by the *Consultant* to cover the cost of corrections to work performed by the *Contractor* that may be required under GC 12.3 – WARRANTY, exceeds the unpaid balance of the *Contract Price*; however, if such cost of finishing the *Work* is less than the unpaid balance of the *Contract Price*, the *Owner* shall pay the *Contractor* the difference, and

.4 on expiry of the warranty period, charge the *Contractor* the amount by which the cost of corrections to the *Contractor*'s work under GC 12.3 – WARRANTY exceeds the allowance provided for such corrections, or if the cost of such corrections is less than the allowance, pay the *Contractor* the difference.

7.1.6 The *Contractor*'s obligation under the *Contract* as to quality, correction and warranty of the work performed by the *Contractor* up to the time of termination shall continue in force after such termination of the *Contract*.

GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

7.2.1 If the *Owner* is adjudged bankrupt, or makes a general assignment for the benefit of creditors because of the *Owner*'s insolvency, or if a receiver is appointed because of the *Owner*'s insolvency, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, terminate the *Contract* by giving the *Owner* or receiver or trustee in bankruptcy *Notice in Writing* to that effect.

7.2.2 If the *Work* is suspended or otherwise delayed for a period of 20 *Working Days* or more under an order of a court or other public authority and providing that such order was not issued as the result of an act or fault of the *Contractor* or of anyone directly or indirectly employed or engaged by the *Contractor*, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, terminate the *Contract* by giving the *Owner Notice in Writing* to that effect.

7.2.3 The *Contractor* may give *Notice in Writing* to the *Owner*, with a copy to the *Consultant*, that the *Owner* is in default of the *Owner*'s contractual obligations if:

.1 the *Owner* fails to furnish, when so requested by the *Contractor*, reasonable evidence that financial arrangements have been made to fulfill the *Owner*'s obligations under the *Contract*,

.2 the *Consultant* fails to issue a certificate as provided in Part 5 of the General Conditions – PAYMENT,

.3 the *Owner* fails to pay the *Contractor* when due the amounts certified by the *Consultant* or awarded by adjudication, arbitration or court, or

.4 the *Owner* fails to comply with the requirements of the *Contract* to a substantial degree and the *Consultant*, except for GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER, gives a written statement to the *Owner* and the *Contractor* that provides detail of such failure to comply with the requirements of the *Contract* to a substantial degree.

7.2.4 The *Contractor*'s *Notice in Writing* to the *Owner* provided under paragraph 7.2.3 shall advise that if the default is not corrected within 5 *Working Days* following the receipt of the *Notice in Writing*, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, suspend the *Work* or terminate the *Contract*.

7.2.5 If the *Contractor* terminates the *Contract* by giving a *Notice in Writing* to the *Owner* under the conditions set out above, the *Contractor* shall be entitled to be paid for all work performed including reasonable profit, for loss sustained upon *Products* and *Construction Equipment*, and such other damages as the *Contractor* may have sustained as a result of the termination of the *Contract*.

PART 8 DISPUTE RESOLUTION

GC 8.1 AUTHORITY OF THE CONSULTANT

8.1.1 Differences between the parties to the *Contract* as to the interpretation, application or administration of the *Contract* or any failure to agree where agreement between the parties is called for, herein collectively called disputes, which are not resolved

in the first instance by findings of the *Consultant* as provided in GC 2.2 – ROLE OF THE CONSULTANT, shall be settled in accordance with the requirements of Part 8 of the General Conditions – DISPUTE RESOLUTION.

8.1.2 If a dispute arises under the *Contract* in respect of a matter in which the *Consultant* has no authority under the *Contract* to make a finding, the procedures set out in paragraph 8.1.3 and paragraphs 8.3.3 to 8.3.8 of GC 8.3 – NEGOTIATION, MEDIATION AND ARBITRATION, and in GC 8.4 – RETENTION OF RIGHTS apply to that dispute with the necessary changes to detail as may be required.

8.1.3 If a dispute is not resolved promptly, the *Consultant* will give such instructions as in the *Consultant*'s opinion are necessary for the proper performance of the *Work* and to prevent delays pending settlement of the dispute. The parties shall act immediately according to such instructions, it being understood that by so doing neither party will jeopardize any claim the party may have. If it is subsequently determined that such instructions were in error or at variance with the *Contract Documents*, the *Owner* shall pay the *Contractor* costs incurred by the *Contractor* in carrying out such instructions which the *Contractor* was required to do beyond what the *Contract Documents* correctly understood and interpreted would have required, including costs resulting from interruption of the *Work*.

GC 8.2 ADJUDICATION

8.2.1 Nothing in this *Contract* shall be deemed to affect the rights of the parties to resolve any dispute by adjudication as may be prescribed by applicable legislation.

GC 8.3 NEGOTIATION, MEDIATION AND ARBITRATION

8.3.1 In accordance with the rules for mediation as provided in CCDC 40 'Rules for Mediation and Arbitration of Construction Industry Disputes' in effect at the time of bid closing, the parties shall appoint a Project Mediator
.1 within 20 *Working Days* after the *Contract* was awarded, or
.2 if the parties neglected to make an appointment within the 20 *Working Days*, within 10 *Working Days* after either party by *Notice in Writing* requests that the Project Mediator be appointed.

8.3.2 A party shall be conclusively deemed to have accepted a finding of the *Consultant* under GC 2.2 – ROLE OF THE CONSULTANT and to have expressly waived and released the other party from any claims in respect of the particular matter dealt with in that finding unless, within 15 *Working Days* after receipt of that finding, the party sends a *Notice in Writing* of dispute to the other party and to the *Consultant*, which contains the particulars of the matter in dispute and the relevant provisions of the *Contract Documents*. The responding party shall send a *Notice in Writing* of reply to the dispute within 10 *Working Days* after receipt of such *Notice in Writing* setting out particulars of this response and any relevant provisions of the *Contract Documents*.

8.3.3 The parties shall make all reasonable efforts to resolve their dispute by amicable negotiations and agree to provide, without prejudice, frank, candid, and timely disclosure of relevant facts, information and documents to facilitate these negotiations.

8.3.4 After a period of 10 *Working Days* following receipt of a responding party's *Notice in Writing* of reply under paragraph 8.3.2, the parties shall request the Project Mediator to assist the parties to reach agreement on any unresolved dispute. The mediated negotiations shall be conducted in accordance with the rules for mediation as provided in CCDC 40 in effect at the time of bid closing.

8.3.5 If the dispute has not been resolved at the mediation or within such further period as is agreed by the parties, the Project Mediator will terminate the mediated negotiations by giving *Notice in Writing* to the *Owner*, the *Contractor* and the *Consultant*.

8.3.6 By giving a *Notice in Writing* to the other party and the *Consultant*, not later than 10 *Working Days* after the date of termination of the mediated negotiations under paragraph 8.3.5, either party may refer the dispute to be finally resolved by arbitration under the rules of arbitration as provided in CCDC 40 in effect at the time of bid closing. The arbitration shall be conducted in the jurisdiction of the *Place of the Work*.

8.3.7 On expiration of the 10 *Working Days*, the arbitration agreement under paragraph 8.3.6 is not binding on the parties and, if a *Notice in Writing* is not given under paragraph 8.3.6 within the required time, the parties may refer the unresolved dispute to the courts or to any other form of dispute resolution, including arbitration, which they have agreed to use.

8.3.8 If neither party, by *Notice in Writing*, given within 10 *Working Days* of the date of *Notice in Writing* requesting arbitration in paragraph 8.3.6, requires that a dispute be arbitrated immediately, all disputes referred to arbitration as provided in paragraph 8.3.6 shall be:
.1 held in abeyance until:
(1) *Ready-for-Takeover*,
(2) the *Contract* has been terminated, or
(3) the *Contractor* has abandoned the *Work*,
whichever is earlier; and

.2 consolidated into a single arbitration under the rules governing the arbitration under paragraph 8.3.6.

GC 8.4 RETENTION OF RIGHTS

8.4.1 It is agreed that no act by either party shall be construed as a renunciation or waiver of any rights or recourses, provided the party has given the *Notice in Writing* required under Part 8 of the General Conditions – DISPUTE RESOLUTION and has carried out the instructions as provided in paragraph 8.1.3 of GC 8.1 – AUTHORITY OF THE CONSULTANT.

8.4.2 Nothing in Part 8 of the General Conditions – DISPUTE RESOLUTION shall be construed in any way to limit a party from asserting any statutory right to a lien under applicable lien legislation of the jurisdiction of the *Place of the Work* and the assertion of such right by initiating judicial proceedings is not to be construed as a waiver of any right that party may have under paragraph 8.3.6 of GC 8.3 – NEGOTIATION, MEDIATION AND ARBITRATION to proceed by way of arbitration to adjudicate the merits of the claim upon which such a lien is based.

PART 9 PROTECTION OF PERSONS AND PROPERTY

GC 9.1 PROTECTION OF WORK AND PROPERTY

9.1.1 The *Contractor* shall protect the *Work*, the *Owner*'s property and property adjacent to the *Place of the Work* from damage which may arise as the result of the *Contractor*'s operations under the *Contract*, and shall be responsible for such damage, except damage which occurs as the result of:
.1 errors or omissions in the *Contract Documents*; or
.2 acts or omissions by the *Owner*, the *Consultant*, *Other Contractors*, or their agents and employees.

9.1.2 Before commencing any work, the *Contractor* shall determine the location of all underground utilities and structures indicated in the *Contract Documents* or that are reasonably apparent in an inspection of the *Place of the Work*.

9.1.3 Should the *Contractor* in the performance of the *Contract* damage the *Work*, the *Owner*'s property or property adjacent to the *Place of the Work*, the *Contractor* shall be responsible for making good such damage at the *Contractor*'s expense.

9.1.4 Should damage occur to the *Work* or the *Owner*'s property for which the *Contractor* is not responsible, as provided in paragraph 9.1.1, the *Contractor* shall make good such damage to the *Work* and, if the *Owner* so directs, to the *Owner*'s property. The *Contract Price* and *Contract Time* shall be adjusted as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.

GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

9.2.1 For the purposes of applicable legislation related to toxic and hazardous substances, the *Owner* shall be deemed to have control and management of the *Place of the Work* with respect to existing conditions.

9.2.2 Prior to the *Contractor* commencing the *Work*, the *Owner* shall,
.1 take all reasonable steps to determine whether any toxic or hazardous substances are present at the *Place of the Work*, and
.2 provide the *Consultant* and the *Contractor* with a written list of any such substances that are known to exist and their locations.

9.2.3 The *Owner* shall take all reasonable steps to ensure that no person's exposure to any toxic or hazardous substance exceeds the time weighted levels prescribed by applicable legislation at the *Place of the Work* and that no property is damaged or destroyed as a result of exposure to, or the presence of, toxic or hazardous substances which were at the *Place of the Work* prior to the *Contractor* commencing the *Work*.

9.2.4 Unless the *Contract* expressly provides otherwise, the *Owner* shall be responsible for taking all necessary steps, in accordance with applicable legislation in force at the *Place of the Work*, to dispose of, store or otherwise render harmless any toxic or hazardous substance which was present at the *Place of the Work* prior to the *Contractor* commencing the *Work*.

9.2.5 If the *Contractor*
.1 encounters toxic or hazardous substances at the *Place of the Work*, or
.2 has reasonable grounds to believe that toxic or hazardous substances are present at the *Place of the Work*,
which were not brought to the *Place of the Work* by the *Contractor* or anyone for whom the *Contractor* is responsible and which were not disclosed by the *Owner* or which were disclosed but have not been dealt with as required under paragraph 9.2.4, the *Contractor* shall
.3 take all reasonable steps, including stopping the *Work*, to ensure that no person's exposure to any toxic or hazardous substance exceeds any applicable time weighted levels prescribed by applicable legislation at the *Place of the Work*, and
.4 immediately report the circumstances to the *Consultant* and the *Owner* in writing.

9.2.6 If the *Owner* and the *Contractor* do not agree on the existence, significance of, or whether the toxic or hazardous substances were brought onto the *Place of the Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Owner* shall retain and pay for an independent qualified expert to investigate and determine such matters. The expert's report shall be delivered to the *Owner* and the *Contractor*.

9.2.7 If the *Owner* and the *Contractor* agree or if the expert referred to in paragraph 9.2.6 determines that the toxic or hazardous substances were not brought onto the place of the *Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Owner* shall promptly at the *Owner's* own expense:

.1 take all steps as required under paragraph 9.2.4;

.2 reimburse the *Contractor* for the costs of all steps taken pursuant to paragraph 9.2.5;

.3 extend the *Contract Time* for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor* and the expert referred to in 9.2.6 and reimburse the *Contractor* for reasonable costs incurred as a result of the delay; and

.4 indemnify the *Contractor* as required by GC 13.1 – INDEMNIFICATION.

9.2.8 If the *Owner* and the *Contractor* agree or if the expert referred to in paragraph 9.2.6 determines that the toxic or hazardous substances were brought onto the place of the *Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Contractor* shall promptly at the *Contractor's* own expense:

.1 take all necessary steps, in accordance with applicable legislation in force at the *Place of the Work*, to safely remove and dispose the toxic or hazardous substances;

.2 make good any damage to the *Work*, the *Owner*'s property or property adjacent to the place of the *Work* as provided in paragraph 9.1.3 of GC 9.1 – PROTECTION OF WORK AND PROPERTY;

.3 reimburse the *Owner* for reasonable costs incurred under paragraph 9.2.6; and

.4 indemnify the *Owner* as required by GC 13.1 – INDEMNIFICATION.

9.2.9 If either party does not accept the expert's findings under paragraph 9.2.6, the disagreement shall be settled in accordance with Part 8 of the General Conditions – DISPUTE RESOLUTION. If such disagreement is not resolved promptly, the parties shall act immediately in accordance with the expert's determination and take the steps required by paragraph 9.2.7 or 9.2.8 it being understood that by so doing, neither party will jeopardize any claim that party may have to be reimbursed as provided by GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES.

GC 9.3 ARTIFACTS AND FOSSILS

9.3.1 Fossils, coins, articles of value or antiquity, structures and other remains or things of scientific or historic interest discovered at the *Place or Work* shall, as between the *Owner* and the *Contractor*, be deemed to be the absolute property of the *Owner*.

9.3.2 The *Contractor* shall take all reasonable precautions to prevent removal or damage to discoveries as identified in paragraph 9.3.1, and shall advise the *Consultant* upon discovery of such items.

9.3.3 The *Consultant* will investigate the impact on the *Work* of the discoveries identified in paragraph 9.3.1. If conditions are found that would cause an increase or decrease in the *Contractor's* cost or time to perform the *Work*, the *Owner*, through the *Consultant*, shall issue appropriate instructions for a change in the *Work* as provided in GC 6.2 – CHANGE ORDER or GC 6.3 – CHANGE DIRECTIVE.

GC 9.4 CONSTRUCTION SAFETY

9.4.1 The *Contractor* shall be responsible for establishing, initiating, maintaining, and supervising all health and safety precautions and programs in connection with the performance of the *Work* in accordance with the applicable health and safety legislation.

9.4.2 The *Owner* and the *Contractor* shall comply with all health and safety precautions and programs established at the *Place of the Work*.

9.4.3 The *Owner* and the *Contractor* shall comply with the rules, regulations and practices required by the applicable health and safety legislation.

9.4.4 The *Owner* shall cause the *Consultant*, *Other Contractors* and the *Owner*'s own forces to comply with all health and safety precautions and programs established by the *Contractor* at the *Place of the Work*.

9.4.5 Nothing in this *Contract* shall affect the determination of liability under the applicable health and safety legislation.

GC 9.5 MOULD

9.5.1 If the *Contractor* or the *Owner* observes or reasonably suspects the presence of mould at the *Place of the Work*, the remediation of which is not expressly part of the *Work*,

.1 the observing party shall promptly report the circumstances to the other party in writing,

.2 the *Contractor* shall promptly take all reasonable steps, including stopping the *Work* if necessary, to ensure that no person suffers injury, sickness or death and that no property is damaged as a result of exposure to or the presence of the mould, and

.3 if the *Owner* and the *Contractor* do not agree on the existence, significance or cause of the mould or as to what steps need be taken to deal with it, the *Owner* shall retain and pay for an independent qualified expert to investigate and determine such matters. The expert's report shall be delivered to the *Owner* and the *Contractor*.

9.5.2 If the *Owner* and the *Contractor* agree, or if the expert referred to in paragraph 9.5.1.3 determines that the presence of mould was caused by the *Contractor*'s operations under the *Contract*, the *Contractor* shall promptly, at the *Contractor*'s own expense:
.1 take all reasonable and necessary steps to safely remediate or dispose of the mould,
.2 make good any damage to the *Work*, the *Owner*'s property or property adjacent to the *Place of the Work* as provided in paragraph 9.1.3 of GC 9.1 – PROTECTION OF WORK AND PROPERTY,
.3 reimburse the *Owner* for reasonable costs incurred under paragraph 9.5.1.3, and
.4 indemnify the *Owner* as required by GC 13.1 – INDEMNIFICATION.

9.5.3 If the *Owner* and the *Contractor* agree, or if the expert referred to in paragraph 9.5.1.3 determines that the presence of mould was not caused by the *Contractor*'s operations under the *Contract*, the *Owner* shall promptly, at the *Owner*'s own expense:
.1 take all reasonable and necessary steps to safely remediate or dispose of the mould,
.2 reimburse the *Contractor* for the cost of taking the steps under paragraph 9.5.1.2 and making good any damage to the *Work* as provided in paragraph 9.1.4 of GC 9.1 – PROTECTION OF WORK AND PROPERTY,
.3 extend the *Contract Time* for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor* and the expert referred to in paragraph 9.5.1.3 and reimburse the *Contractor* for reasonable costs incurred as a result of the delay, and
.4 indemnify the *Contractor* as required by GC 13.1 – INDEMNIFICATION.

9.5.4 If either party does not accept the expert's finding under paragraph 9.5.1.3, the disagreement shall be settled in accordance with Part 8 of the General Conditions – DISPUTE RESOLUTION. If such disagreement is not resolved promptly, the parties shall act immediately in accordance with the expert's determination and take the steps required by paragraphs 9.5.2 or 9.5.3, it being understood that by so doing neither party will jeopardize any claim the party may have to be reimbursed as provided by GC 9.5 – MOULD.

PART 10 GOVERNING REGULATIONS

GC 10.1 TAXES AND DUTIES

10.1.1 The *Contract Price* shall include all taxes and customs duties in effect at the time of the bid closing except for *Value Added Taxes* payable by the *Owner* to the *Contractor* as stipulated in Article A-4 of the Agreement – CONTRACT PRICE.

10.1.2 Any increase or decrease in costs to the *Contractor* due to changes in taxes and duties after the time of the bid closing shall increase or decrease the *Contract Price* accordingly.

GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

10.2.1 The laws of the *Place of the Work* shall govern the *Work*.

10.2.2 The *Owner* shall obtain and pay for development approvals, building permit, permanent easements, rights of servitude, and all other necessary approvals and permits, except for the permits and fees referred to in paragraph 10.2.3 or for which the *Contract Documents* specify as the responsibility of the *Contractor*.

10.2.3 The *Contractor* shall be responsible for the procurement of permits, licences, inspections, and certificates, which are necessary for the performance of the *Work* and customarily obtained by contractors in the jurisdiction of the *Place of the Work* after the issuance of the building permit. The *Contract Price* includes the cost of these permits, licences, inspections, and certificates, and their procurement.

10.2.4 The *Contractor* shall give the required notices and comply with the laws, ordinances, rules, regulations, or codes which are or become in force during the performance of the *Work* and which relate to the *Work*, to the preservation of the public health, and to construction safety.

10.2.5 The *Contractor* shall not be responsible for verifying that the *Contract Documents* are in compliance with the applicable laws, ordinances, rules, regulations, or codes relating to the *Work*. If the *Contract Documents* are at variance therewith, or if, subsequent to the time of bid closing, changes are made to the applicable laws, ordinances, rules, regulations, or codes which require modification to the *Contract Documents*, the *Contractor* shall advise the *Consultant* in writing requesting direction immediately upon such variance or change becoming known. The *Consultant* will issue the changes required to the *Contract Documents* as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.

10.2.6 If the *Contractor* fails to advise the *Consultant* in writing; fails to obtain direction as required in paragraph 10.2.5; and performs work knowing it to be contrary to any laws, ordinances, rules, regulations, or codes; the *Contractor* shall be responsible for and shall correct the violations thereof; and shall bear the costs, expenses and damages attributable to the failure to comply with the provisions of such laws, ordinances, rules, regulations, or codes.

10.2.7 If, subsequent to the time of bid closing, changes are made to applicable laws, ordinances, rules, regulations, or codes of authorities having jurisdiction which affect the cost of the *Work*, either party may submit a claim in accordance with the requirements of GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE.

GC 10.3 PATENT FEES

10.3.1 The *Contractor* shall pay the royalties and patent licence fees required for the performance of the *Contract*. The *Contractor* shall hold the *Owner* harmless from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor*'s performance of the *Contract* which are attributable to an infringement or an alleged infringement of a patent of invention by the *Contractor* or anyone for whose acts the *Contractor* may be liable.

10.3.2 The *Owner* shall hold the *Contractor* harmless against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor*'s performance of the *Contract* which are attributable to an infringement or an alleged infringement of a patent of invention in executing anything for the purpose of the *Contract*, the physical model, plan or design of which was supplied to the *Contractor* as part of the *Contract*.

GC 10.4 WORKERS' COMPENSATION

10.4.1 Prior to commencing the *Work*, and again with the *Contractor*'s applications for payment, the *Contractor* shall provide evidence of compliance with workers' compensation legislation at the *Place of the Work*.

PART 11 INSURANCE

GC 11.1 INSURANCE

11.1.1 Without restricting the generality of GC 13.1 – INDEMNIFICATION, the *Contractor* shall provide, maintain and pay for the following insurance coverages, the requirements of which are specified in CCDC 41 'CCDC Insurance Requirements' in effect at the time of bid closing except as hereinafter provided:

.1 General liability insurance in the name of the *Contractor* and include, or in the case of a single, blanket policy, be endorsed to name, the *Owner* and the *Consultant* as insureds but only with respect to liability, other than legal liability arising out of their sole negligence, arising out of the operations of the *Contractor* with regard to the *Work*. General liability insurance shall be maintained from the date of commencement of the *Work* until one year from the date of *Ready-for-Takeover*. Liability coverage shall be provided for completed operations hazards from the date of *Ready-for-Takeover* on an ongoing basis for a period of 6 years following *Ready-for-Takeover*.

.2 Automobile Liability Insurance from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.

.3 Unmanned aerial vehicle aircraft, manned aircraft or watercraft Liability Insurance when owned or non-owned manned or unmanned aircraft or watercraft are used directly or indirectly in the performance of the *Work*.

.4 "Broad form" property insurance in the joint names of the *Contractor*, the *Owner* and the *Consultant*. The policy shall include as insureds all *Subcontractors*. The "Broad form" property insurance shall be provided from the date of commencement of the *Work* until the earliest of:

(1) 10 calendar days after the date of *Ready-for-Takeover*;

(2) on the commencement of use or occupancy of any part or section of the *Work* unless such use or occupancy is for construction purposes, habitational, office, banking, convenience store under 465 square metres in area, or parking purposes, or for the installation, testing and commissioning of equipment forming part of the *Work*; and

(3) when left unattended for more than 30 consecutive calendar days or when construction activity has ceased for more than 30 consecutive calendar days.

.5 Boiler and machinery insurance in the joint names of the *Contractor*, the *Owner* and the *Consultant*. The policy shall include as insureds all *Subcontractors*. The coverage shall be maintained continuously from commencement of use or operation of the boiler and machinery objects insured by the policy and until 10 calendar days after the date of *Ready-for-Takeover*.

.6 The "Broad form" property and boiler and machinery policies shall provide that, in the case of a loss or damage, payment shall be made to the *Owner* and the *Contractor* as their respective interests may appear. In the event of loss or damage:

(1) the *Contractor* shall act on behalf of the *Owner* for the purpose of adjusting the amount of such loss or damage payment with the insurers. When the extent of the loss or damage is determined, the *Contractor* shall proceed to restore the *Work*. Loss or damage shall not affect the rights and obligations of either party under the *Contract* except

that the *Contractor* shall be entitled to such reasonable extension of *Contract Time* relative to the extent of the loss or damage as the *Consultant* may recommend in consultation with the *Contractor*;

(2) the *Contractor* shall be entitled to receive from the *Owner*, in addition to the amount due under the *Contract*, the amount which the *Owner*'s interest in restoration of the *Work* has been appraised, such amount to be paid as the restoration of the *Work* proceeds in accordance with the progress payment provisions. In addition the *Contractor* shall be entitled to receive from the payments made by the insurer the amount of the *Contractor*'s interest in the restoration of the *Work*; and

(3) to the *Work* arising from the work of the *Owner*, the *Owner*'s own forces or *Other Contractors*, the *Owner* shall, in accordance with the *Owner*'s obligations under the provisions relating to construction by the *Owner* or *Other Contractors*, pay the *Contractor* the cost of restoring the *Work* as the restoration of the *Work* proceeds and as in accordance with the progress payment provisions.

.7 Contractors' Equipment Insurance from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.

.8 Contractors' Pollution Liability Insurance from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.

11.1.2 Prior to commencement of the *Work* and upon the placement, renewal, amendment, or extension of all or any part of the insurance, the *Contractor* shall promptly provide the *Owner* with confirmation of coverage and, if required, a certified true copy of the policies certified by an authorized representative of the insurer together with copies of any amending endorsements applicable to the *Work*.

11.1.3 The parties shall pay their share of the deductible amounts in direct proportion to their responsibility in regards to any loss for which the above policies are required to pay, except where such amounts may be excluded by the terms of the *Contract*.

11.1.4 If the *Contractor* fails to provide or maintain insurance as required by the *Contract Documents*, then the *Owner* shall have the right to provide and maintain such insurance and give evidence to the *Contractor* and the *Consultant*. The *Contractor* shall pay the cost thereof to the *Owner* on demand or the *Owner* may deduct the cost from the amount which is due or may become due to the *Contractor*.

11.1.5 All required insurance policies shall be with insurers licensed to underwrite insurance in the jurisdiction of the *Place of the Work*.

11.1.6 If a revised version of CCDC 41 is published, which specifies reduced insurance requirements, the parties shall address such reduction, prior to the *Contractor*'s insurance policy becoming due for renewal, and record any agreement in a *Change Order*.

11.1.7 If a revised version of CCDC 41 is published, which specifies increased insurance requirements, the *Owner* may request the increased coverage from the *Contractor* by way of a *Change Order*.

11.1.8 A *Change Directive* shall not be used to direct a change in the insurance requirements in response to the revision of CCDC 41.

PART 12 OWNER TAKEOVER

GC 12.1 READY-FOR-TAKEOVER

12.1.1 The prerequisites to attaining *Ready-for-Takeover* of the *Work* are limited to the following:

.1 The *Consultant* has certified or verified the *Substantial Performance of the Work*.

.2 Evidence of compliance with the requirements for occupancy or occupancy permit as prescribed by the authorities having jurisdiction.

.3 Final cleaning and waste removal at the time of applying for *Ready-for-Takeover*, as required by the *Contract Documents*.

.4 The delivery to the *Owner* of such operations and maintenance documents reasonably necessary for immediate operation and maintenance, as required by the *Contract Documents*.

.5 Make available a copy of the as-built drawings completed to date on site.

.6 Startup, testing required for immediate occupancy, as required by the *Contract Documents*.

.7 Ability to secure access to the *Work* has been provided to the *Owner*, if required by the *Contract Documents*.

.8 Demonstration and training, as required by the *Contract Documents*, is scheduled by the *Contractor* acting reasonably.

12.1.2 If any prerequisites set forth in paragraphs 12.1.1.3 to 12.1.1.6 must be deferred because of conditions reasonably beyond the control of the *Contractor*, or by agreement between the *Owner* and the *Contractor* to do so, *Ready-for-Takeover* shall not be delayed.

12.1.3 When the *Contractor* considers that the *Work* is *Ready-for-Takeover*, the *Contractor* shall deliver to the *Consultant* and to the *Owner* a comprehensive list of items to be completed or corrected, together with a written application for *Ready-for-Takeover* for review. Failure to include an item on the list does not alter the responsibility of the *Contractor* to complete the *Contract*.

12.1.4 The *Consultant* will review the *Work* to verify the validity of the application and will promptly, and in any event, no later than 10 calendar days after receipt of the *Contractor*'s list and application:

.1 advise the *Contractor* in writing that the *Work* is not *Ready-for-Takeover* and give reasons why, or
.2 confirm the date of *Ready-for-Takeover* in writing to each of the *Owner* and the *Contractor*.

12.1.5 Immediately following the confirmation of the date of *Ready-for-Takeover*, the *Contractor*, in consultation with the *Consultant*, shall establish a reasonable date for finishing the *Work*.

12.1.6 The provision of GC 12.1 – READY-FOR-TAKEOVER shall be subject to GC 12.2 – EARLY OCCUPANCY BY THE OWNER.

GC 12.2 EARLY OCCUPANCY BY THE OWNER

12.2.1 The *Owner* may take occupancy of a part or the entirety of the *Work* before *Ready-for-Takeover* has been attained only as agreed by the *Contractor* which agreement shall not be unreasonably withheld.

12.2.2 The *Owner* shall not occupy a part or the entirety of the *Work* without prior approval by authorities having jurisdiction.

12.2.3 If the *Owner* takes occupancy of a part of the *Work* before *Ready-for-Takeover* has been attained:
.1 The part of the *Work* which is occupied shall be deemed to have been taken over by the *Owner* as from the date on which it is occupied.
.2 The *Contractor* shall cease to be liable for the care of such part as from this date, when responsibility shall pass to the *Owner*.
.3 The warranty period specified in paragraph 12.3.1 of GC 12.3 – WARRANTY for that part of the *Work* shall start from the date on which it is occupied.

12.2.4 If the *Owner* takes occupancy of the entirety of the *Work* before all the prerequisites are met as described in paragraph 12.1.1 of GC 12.1 – READY-FOR-TAKEOVER, the *Work* shall, subject to the requirements of the applicable lien legislation, be deemed to achieve *Ready-for-Takeover*. This shall not relieve the *Contractor*'s responsibility to complete the *Work* in a timely manner.

GC 12.3 WARRANTY

12.3.1 Except for extended warranties as described in paragraph 12.3.6, the warranty period under the *Contract* is one year from the date when *Ready-for-Takeover* has been attained.

12.3.2 The *Contractor* shall be responsible for the proper performance of the *Work* to the extent that the design and *Contract Documents* permit such performance.

12.3.3 The *Owner*, through the *Consultant*, shall promptly give the *Contractor Notice in Writing* of observed defects and deficiencies which occur during the one year warranty period.

12.3.4 Subject to paragraph 12.3.2, the *Contractor* shall correct promptly, at the *Contractor*'s expense, defects or deficiencies in the *Work* which appear prior to and during the one year warranty period.

12.3.5 The *Contractor* shall correct or pay for damage resulting from corrections made under the requirements of paragraph 12.3.4.

12.3.6 Any extended warranties required beyond the one year warranty period as described in paragraph 12.3.1, shall be as specified in the *Contract Documents*. Extended warranties shall be issued by the warrantor to the benefit of the *Owner*. The *Contractor*'s responsibility with respect to extended warranties shall be limited to obtaining any such extended warranties from the warrantor. The obligations under such extended warranties are solely the responsibilities of the warrantor.

PART 13 INDEMNIFICATION AND WAIVER

GC 13.1 INDEMNIFICATION

13.1.1 Without restricting the parties' obligation to indemnify respecting toxic and hazardous substances, patent fees and defect in title claims all as described in paragraphs 13.1.4 and 13.1.5, the *Owner* and the *Contractor* shall each indemnify and hold harmless the other from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings whether in respect to losses suffered by them or in respect to claims by third parties that arise out of, or are attributable in any respect to their involvement as parties to this *Contract*, provided such claims are:
.1 caused by:
(1) the negligent acts or omissions of the party from whom indemnification is sought or anyone for whose negligent acts or omissions that party is liable, or
(2) a failure of the party to the *Contract* from whom indemnification is sought to fulfill its terms or conditions; and
.2 made by *Notice in Writing* within a period of 6 years from the *Ready-for-Takeover* date or within such shorter period as may be prescribed by any limitation statute of the Province or Territory of the *Place of the Work*.
The parties expressly waive the right to indemnity for claims other than those provided for in this *Contract*.

13.1.2 The obligation of either party to indemnify as set forth in paragraph 13.1.1 shall be limited as follows:

.1 In respect to losses suffered by the *Owner* and the *Contractor* for which insurance is to be provided by either party pursuant to GC 11.1 – INSURANCE, the minimum liability insurance limit for one occurrence, of the applicable insurance policy, as referred to in CCDC 41 in effect at the time of bid closing.

.2 In respect to losses suffered by the *Owner* and the *Contractor* for which insurance is not required to be provided by either party in accordance with GC 11.1 – INSURANCE, the greater of the *Contract Price* as recorded in Article A-4 – CONTRACT PRICE or $2,000,000, but in no event shall the sum be greater than $20,000,000.

.3 In respect to indemnification by a party against the other with respect to losses suffered by them, such obligation shall be restricted to direct loss and damage, and neither party shall have any liability to the other for indirect, consequential, punitive or exemplary damages.

.4 In respect to indemnification respecting claims by third parties, the obligation to indemnify is without limit.

13.1.3 The obligation of either party to indemnify the other as set forth in paragraphs 13.1.1 and 13.1.2 shall be inclusive of interest and all legal costs.

13.1.4 The *Owner* and the *Contractor* shall indemnify and hold harmless the other from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of their obligations described in GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES.

13.1.5 The *Owner* shall indemnify and hold harmless the *Contractor* from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings:

.1 as described in paragraph 10.3.2 of GC 10.3 – PATENT FEES, and

.2 arising out of the *Contractor*'s performance of the *Contract* which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the *Place of the Work.*

13.1.6 In respect to any claim for indemnity or to be held harmless by the *Owner* or the *Contractor*:

.1 *Notice in Writing* of such claim shall be given within a reasonable time after the facts upon which such claim is based become known; and

.2 should any party be required as a result of its obligation to indemnify another to pay or satisfy a final order, judgment or award made against the party entitled by this contract to be indemnified, then the indemnifying party upon assuming all liability for any costs that might result shall have the right to appeal in the name of the party against whom such final order or judgment has been made until such rights of appeal have been exhausted.

GC 13.2 WAIVER OF CLAIMS

13.2.1 Subject to any lien legislation applicable to the *Place of the Work*, the *Contractor* waives and releases the *Owner* from all claims which the *Contractor* has or reasonably ought to have knowledge of that could be advanced by the *Contractor* against the *Owner* under the *Contract*, including, without limitation, those arising from negligence or breach of contract in respect to which the cause of action is based upon acts or omissions which occurred prior to or on the *Ready-for-Takeover* date, except as follows:

.1 claims arising prior to or on the *Ready-for-Takeover* date for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* no later than 5 calendar days before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work* or 20 calendar days following the *Ready-for-Takeover* date, whichever is later;

.2 indemnification for claims advanced against the *Contractor* by third parties for which a right of indemnification may be asserted by the *Contractor* against the *Owner* pursuant to the provisions of this *Contract*;

.3 claims respecting toxic and hazardous substances, patent fees and defect in title matters for which a right of indemnity could be asserted by the *Contractor* pursuant to the provisions of paragraphs 13.1.4 or 13.1.5 of GC 13.1 – INDEMNIFICATION; and

.4 claims resulting from acts or omissions which occur after the *Ready-for-Takeover* date.

13.2.2 The *Contractor* waives and releases the *Owner* from all claims resulting from acts or omissions which occurred after the *Ready-for-Takeover* date except for:

.1 indemnification respecting third party claims, and claims respecting toxic and hazardous substances, patent fees and defect in title matters, all as referred in paragraphs 13.2.1.2 and 13.2.1.3; and

.2 claims for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* within 395 calendar days following the *Ready-for-Takeover* date.

13.2.3 Subject to any lien legislation applicable to the *Place of the Work*, the *Owner* waives and releases the *Contractor* from all claims which the *Owner* has or reasonably ought to have knowledge of that could be advanced by the *Owner* against the *Contractor* under the *Contract*, including, without limitation, those arising from negligence or breach of contract in respect to which the cause of action is based upon acts or omissions which occurred prior to or on the *Ready-for-Takeover* date, except as follows:

.1 claims arising prior to or on the *Ready-for-Takeover* date for which *Notice in Writing* of claim has been received by the *Contractor* from the *Owner* no later than 20 calendar days following the *Ready-for-Takeover* date;

.2 indemnification for claims advanced against the *Owner* by third parties for which a right of indemnification may be asserted by the *Owner* against the *Contractor* pursuant to the provisions of this *Contract*;
.3 claims respecting toxic and hazardous substances for which a right of indemnity could be asserted by the *Owner* against the *Contractor* pursuant to the provisions of paragraph 13.1.4 of GC 13.1 – INDEMNIFICATION;
.4 damages arising from the *Contractor*'s actions which result in substantial defects or deficiencies in the *Work*. "Substantial defects or deficiencies" mean those defects or deficiencies in the *Work* which affect the *Work* to such an extent or in such a manner that a significant part or the whole of the *Work* is unfit for the purpose intended by the *Contract Documents*;
.5 claims arising pursuant to GC 12.3 – WARRANTY; and
.6 claims arising from acts or omissions which occur after the *Ready-for-Takeover* date.

13.2.4 Respecting claims arising upon substantial defects and deficiencies in the *Work*, as referenced in paragraph 13.2.3.4, and notwithstanding paragraph 13.2.3.5, the *Owner* waives and releases the *Contractor* from all claims except claims for which *Notice in Writing* of claim has been received by the *Contractor* from the *Owner* within a period of six years from the *Ready-for-Takeover* date, provided that any limitation statute of the Province or Territory of the *Place of the Work* permit such agreement. If the applicable limitation statute does not permit such agreement, the time within which any such claim may be brought shall be such shorter period as may be prescribed by any limitation statute of the Province or Territory of the *Place of the Work*.

13.2.5 The *Owner* waives and releases the *Contractor* from all claims arising from acts or omissions which occur after the *Ready-for-Takeover* date, except for:
.1 indemnification for claims advanced against the *Owner* by third parties, as referenced in paragraph 13.2.3.2;
.2 claims respecting toxic and hazardous substances for which a right of indemnity could be asserted by the *Owner* against the *Contractor*, as referenced in paragraph 13.2.3.3;
.3 claims arising under GC 12.3 – WARRANTY; and
.4 claims for which *Notice is Writing* has been received by the *Contractor* from the *Owner* within 395 calendar days following the *Ready-for-Takeover* date.

13.2.6 "*Notice in Writing* of claim" as provided for in GC 13.2 – WAIVER OF CLAIMS to preserve a claim or right of action which would otherwise, by the provisions of GC 13.2 – WAIVER OF CLAIMS, be deemed to be waived, must include the following:
.1 a clear and unequivocal statement of an intention to claim;
.2 a statement as to the nature of the claim and the grounds upon which the claim is based; and
.3 a statement of the estimated quantum of the claim.

13.2.7 A claim for lien asserted under the lien legislation prevailing at the *Place of the Work* shall qualify as notice of claim for the purposes of this *Contract*.

13.2.8 The party giving the *Notice in Writing* of claim as provided for in GC 13.2 – WAIVER OF CLAIMS shall submit within a reasonable time a detailed account of the amount claimed.

13.2.9 Where the event or series of events giving rise to a claim made under paragraphs 13.2.1 or 13.2.3 has a continuing effect, the detailed account submitted under paragraph 13.2.8 shall be considered to be an interim account and the party making the claim shall submit further interim accounts, at reasonable intervals, giving the accumulated amount of the claim and any further grounds upon which such claim is based. The party making the claim shall submit a final account after the end of the effects resulting from the event or series of events.

13.2.10 Nothing in GC 13.2 – WAIVER OF CLAIMS shall be deemed to affect the rights of the parties under any lien legislation or limitations legislation prevailing at the *Place of the Work*.

The Corporation of the City of Kenora
Occupational Health and Safety Policy

The Corporation of the City of Kenora is committed to preventing occupational illness and injury in the workplace.

We recognize that an effective health and safety program, as indicated by following acceptable industry practices and compliance with legislative requirements, and communication of that program to all workers, will contribute to a reduced risk of injury or illness to workers.

We further recognize that health and safety is the shared commitment and responsibility of us all. Our program is based on the concepts of the Internal Responsibility System wherein responsibilities and authority for health and safety are delegated from the top down and accountability for performance is required from the bottom up.

The Senior Leadership Team is responsible for establishing health and safety policy and ensuring the development of a health and safety system.

Division Managers are responsible for the development and implementation of health and safety programs in their divisions and for ensuring that their Division Leads are performing their required health and safety responsibilities.

Division Leads and all supervisory personnel are responsible to enforce health and safety rules and regulations and to ensure that their workers have the appropriate training, skills, and qualifications to perform their tasks safely.

Workers are responsible to follow employer and regulatory procedures, use their initiative to reduce risk, and to report unresolved issues to their supervisor.

It is the intention of this policy that:

"No job is so important and no service is so urgent that we cannot take the time to perform our work safely"

Chief Administrative Officer **Mayor**

Approved by Municipal Council on March 16, 2021

Health and Safety Responsibilities - Contractors

Section Health and Safety Policies	**Date** March 19, 2012	**Approved by By-law Number:** 27-2012	**Page** 1	**Of** 4
Subsection Responsibilities and Accountabilities	**Supersedes By-law Number:** 105-2011		**Policy Number:** HS-05	

PURPOSE

It is the policy of the City of Kenora to require that the provisions of the Occupational Health and Safety Act (Act) and applicable Regulations are complied with:

- where the City of Kenora contracts the performance of work or services (non-construction); and
- where the City of Kenora contracts a "constructor" (as defined in section 1 of the Act) to undertake a project (construction).

The purpose of these requirements is to ensure that all reasonable precautions are taken:

- for the protection of workers; and
- so that the City of Kenora is duly diligent in their duties and responsibilities under the Act.

RESPONSIBILITY

Contract Personnel

Contract personnel are responsible to:

- comply with the requirements of this policy and guideline;
- use their training, knowledge and experience to protect the health and safety of themselves and others;
- report to their supervisor the absence of, or defect in any protective equipment or device; and
- report to their supervisor, any circumstances or conditions that may limit their ability to comply with the requirements of this policy and guideline.

Contractors

Contractors are responsible to:

- enforce and comply with the requirements of this policy and guideline; and
- ensure that their workers are aware of this policy and guideline.

Supervisors (Both City of Kenora and Contract Personnel)

Supervisors are responsible to ensure that:

- contract personnel (non-construction) work in compliance with the requirements of this policy and guideline;

- contract personnel (non-construction) are aware of the requirements of this policy and guideline;
- protective equipment and devices required to carry out the requirements of this policy and guideline are provided; and
- protective equipment and devices that are provided are maintained in good condition.

Management
Managers are responsible for ensuring all City of Kenora operations are in compliance with applicable legislation and the requirements of this policy and guideline.

PROCEDURE

General
All contractors are required where applicable, to provide to the City of Kenora upon request the following:
- WSIB certificate of clearance;
- third party liability insurance (minimum $2 million);
- where applicable, federal, provincial and municipal licensing, certification, notification, inspection and approvals;
- occupational health and safety policy and program;
- applicable training documentation for supervisors and workers as specified by The City of Kenora;
- hazardous materials and designated substance inventories; and
- records of health and safety violations and convictions under the Act.

Service Contractors (Non-construction)
In addition to the duties and responsibilities imposed on contractors under the Act, service contractors will ensure:
- the applicable requirements of the City of Kenora's health and safety program are communicated to, understood by and complied with by the workers of the contractor;
- the measures and procedures required by the Act and Regulations (applicable to the work) are carried out;
- appropriate documentation of instruction and communication are maintained and available for review by the City of Kenora; and
- any and all other precautions deemed necessary by the City of Kenora for safeguarding workers, equipment and property are carried out.

The City of Kenora will gauge contractor compliance with these requirements, and reserves the right to terminate services' contracts for any and all violations.
Contractors (and their workers) are required to attend any and all safety related meetings as deemed appropriate by the City of Kenora.

Project Contractors (Construction Projects)
In addition to the duties and responsibilities imposed on contractors (who undertake a construction project for the City of Kenora) under the Act, contractors will ensure:

- the City of Kenora's health and safety requirements for contractors (construction) are incorporated into the project health and safety program;
- a project hazard assessment review is conducted, prepared and submitted to the City of Kenora which includes;
    - analysis and evaluation of hazards;
    - application of controls;
    - instruction and information provided to supervisors and workers regarding hazards;
    - hazardous materials inventory;
    - operational, maintenance and emergency procedures specific to the project assessment; and
    - training in the necessary procedures;
- a written health and safety policy is available, posted and communicated to all workers on the project;
- a project safety program is developed and implemented that details how the contractor will ensure compliance with subsections 23(1), 25(1) and 25(2) of the Act;
- a designated safety representative coordinates health and safety on the project; and
- the designated safety representative attends a project pre-meeting with representatives of the City of Kenora.

Equipment
The contractor is responsible to provide, maintain and ensure that all equipment necessary, including personal protective equipment, is properly used or worn for the duration of the work.
All equipment used by the contractor shall conform to the manufacturer's specifications and comply with all applicable legislation. The City of Kenora reserves the right to prohibit the use of any equipment, methods or practices that do not conform to acceptable standards. Equipment shall be removed from the City of Kenora's premises immediately upon completion of the work.

TRAINING

All City of Kenora personnel involved with contracting of work will be made aware of the contents of this policy. All training will be documented.

REFERENCES

Occupational Health and Safety Act (Ontario) – Section 23
Wrokwell Core Health and Safety Audit – Element 2.1 (i) and (j)

City of Kenora
Contractor Safety Program

Introduction

The City of Kenora is committed to the health and safety of all of our employees, and expects the same commitment from each contractor to their own employees.

The City of Kenora has developed this program for use by all contractors who perform work or provide services on City of Kenora premises. Contractors include all on-site service providers, construction contractors and all sub-contractors. Outside carriers, delivery, or pick-up personnel are generally not required to complete the Contractor Safety Program requirements unless the scope of the service that they provide will go beyond the routine delivery or pick-up of commodities at approved points within the City of Kenora. Outside Trainers or Consultants generally are not required to complete the Contractor Safety Program requirements unless the scope of the service that they provide will include health and safety hazards.

This program does not cover all of the site-specific or even project-specific health and safety issues that may arise. This program is by no means meant to be all inclusive of the requirements of the *Occupational Health and Safety Act* (hereinafter referred to as the *Act*) or any other applicable legislation.

The Contractor Safety Program consists of three elements:

1. The General Workplace Safety Requirements for Contractors

This section is a compilation of the specific information that Contractors need to know before and be aware of during the performance of work for the City of Kenora in order to ensure compliance with the program. Not all information in this section applies to all contractors. It is up to individual contractors to review this section and understand the applicable sections based on the work or service that they will be providing to the City of Kenora.

2. Contractor Declaration and Documentation Requirements Checklist

Prior to performing work for the City of Kenora, all new contractors must complete the Contractor Declaration and submit the documentation required as outlined on the form to the City Representative. The declaration must be signed by a representative of the Contractor who has the authority to commit the Contractor to comply with the General Workplace Safety Requirements for Contractors.

3. City of Kenora Contractor Orientation Checklist

It is the Contractor's responsibility to review the General Workplace Safety Requirements for Contractors document with their employees.

Prior to work commencing, the City Representative must complete the orientation checklist with the Contractor. This session will outline the site specific hazards, and emergency and reporting procedures.

City of Kenora

General Workplace Safety Requirements for Contractors

1. Unless explicitly referenced elsewhere in contract documentation, the Contractor will be designated as the Constructor, as defined by the *Act*, for the purposes of construction project work. As Constructor the Contractor will assume all of the responsibilities as set out in the *Act* and its regulations and shall enforce strict compliance therewith.

2. The Contractor must have an Occupational Health and Safety Policy and a program to implement that policy.

3. The Contractor shall ensure that work is conducted in a safe manner consistent with the intent of the *Act*, and any other Act, regulation, or by-law. Violations of any such legislation may result in the Contractor being removed from the project.

4. The Contractor shall appoint a person to supervise the work and that person shall be a *competent person*, as defined by the *Act*. The Contractor shall provide documentation to the City's Representative as evidence of the individual's competence. This could include training records or other such documentation as may be appropriate.

5. During the execution of the work, the Contractor shall ensure that:

a) worker safety is given first priority in planning, pricing, and performing the work;

b) its officers and supervisory employees have a working knowledge of the duties of a constructor and employer as defined by the Act and the provisions of the regulations applicable to the work, and a personal commitment to comply with them:

c) a copy of the most current printing of the Act and applicable regulations are available at the Contractor's office within the working area or, in the absence of an office, in the possession of the supervisor responsible for the performance of the work;

d) workers employed to carry out the work must possess the knowledge, skills, and protective devices required by law or recommended by a recognized industry association to allow them to work safely;

e) its supervisory employees are competent person as defined by the Act and they carry out their duties in a diligent and responsible manner with due consideration for the health and safety of the workers;

f) all subcontractors and their employees are properly protected from injury and illness while they are at the workplace.

6. Where required by the Act and its regulations, the Contractor shall register the project with the Ministry of Labour's Construction Health and Safety Branch prior to starting work on the site. The Contractor shall pay all registration fees. A copy of the registration must be posted in a visible location at the site, and submitted to the City's Representative before starting work on site.

7. The Contractor shall have a written emergency plan, which includes a process for addressing critical injuries, accidents, and incidents as required by sections 51, 52, and 53 of the Act/ The plan must be readily available. If work is on a project, the emergency plan shall be posted on site prior to any work commencement.

8. Where required, the contractor shall provide a telephone, appropriate first aid facilities, eye wash stations and any other measures required for emergency use as identified in the emergency plan.

9. The contractor shall conduct regular workplace inspections in accordance with the Act. The contractor must immediately address any preventive or corrective measures required to maintain site safety.

10. The contractor shall, throughout the course of the work, make the City's representative aware of all accidents/incidents that occur involving the contractor or the contractor's employees.

11. The City's representative will stop the work immediately for any violation of the Act or regulations that they become aware of. The contractor shall not resume the work until any such violation has been rectified.

12. The contractor shall be responsible for any delay in the progress of the work due to a violation of legislated requirements or City health and safety requirements of which the contractor has been advised, and shall take the necessary steps to avoid delay in the final completion of the work without additional cost to the City.

Declaration

I have received and read the "City of Kenora Contractor Safety Program". As the owner or authorized representative of the contracted services, I understand that I am fully responsible for ensuring that all of our employees, subcontractors, and visitors comply with all necessary rules and regulations outlined therein and with all applicable regulations made under the Occupational Health and Safety Act.

Name: _____

Signature: _____

Company Name: _____

Witness: _____

Contractor Document Requirements

The documentation required from the contractor will be dependent on the scope of the work to be performed. Prior to commencement of work the contractor will be advised as to which of the following documentation will need to be provided to the City of Kenora Representative for review. This list is not intended to be all inclusive and additional documentation may be requested at the discretion of the City of Kenora Representative.

- □ Contractor Safety Policy
- □ Certificate of Liability Insurance
- □ Valid WSIB Clearance Certificate
- □ Certificate of Personal Disability Coverage
- □ Supervisor's Name and Phone Number
- □ Contractor's List of First Aiders
- □ Contractor's Emergency Contact Numbers
- □ Training Records Supporting Competency of Supervisor
- □ Approved Registration Form (As per Section 5 of O. Reg. 213/91)
- □ Notice of Project Form if Required (As per Section 6 of O. Reg. 213/91)
- □ Generator Registration Number (if removing hazardous waste)

_____	_____
City Representative Name	Owner of the Contracted Services
_____	_____
Signature of City Representative	Signature of Owner

Contractor Initial Orientation

Prior to any "work" being done by the contractor, an initial orientation must be held. The City Representative shall conduct this orientation. Work must never begin before the orientation has taken place and information is conveyed to all contractor employees. If all contractor employees are not present for the orientation, it is the responsibility of the Contractor Representative to convey this information to the contractor employees.

Where there is an established scope of work, location, conditions, hazards, and they will not change during a twelve-month period, then a yearly orientation can be held.

The City's Representative is to review and check off the following items with the contractor:

- □ Inform the contractor of the Health and Safety hazards or requirements of the area in which they will be working. The contractor site supervisor (or appropriate designate) is responsible to convey this information to all contract personnel working on the project or job.

- □ The City of Kenora emergency procedures and evacuation procedures as they apply to the work being performed.

_____ _____
City Representative Name Contractor Name

_____ _____
City Representative Signature Contractor Signature

_____
Date

Appendix

Internal Procedures for Hiring Contractors

The City of Kenora is committed to the health and safety of all our employees and expects the same commitment from each contractor to their own employees.

A City representative is the point of contact for the contractor while performing work for the City of Kenora.

Definitions (from the Occupational Health and Safety Act)

Competent person means a person who:
(a) is qualified because of knowledge, training and experience to organize the work and its performance,
(b) is familiar with this Act and the regulations that apply to the work, and
(c) has knowledge of any potential or actual danger to health or safety in the workplace.

Construction includes erection, alteration, repair, dismantling, demolition, structural maintenance, painting, land clearing, earth moving, grading, excavating, trenching, digging, boring, drilling, blasting, or concreting, the installation of any machinery or plant, and any work or undertaking in connection with a project but does not include any work or undertaking underground in a mine.

Maintenance vs. Construction – According to the Ministry of Labour's Construction vs. Maintenance Policy, contract work is considered construction if the contract activities are mentioned in the definition of construction and are performed on objects mentioned in the definition of project. Those construction activities not performed on objects mentioned in the definition of project would be considered maintenance and would be covered by the industrial regulations. For example, an alteration, repair, or dismantling performed on a building, bridge, or structure, is construction, whereas the same activities carried out on machinery or equipment would be maintenance. Similarly, structural maintenance and installations are considered to be construction, whereas routine plant maintenance is considered to be maintenance.

Constructor means a person who undertakes a project for an owner and includes an owner who undertakes all or part of a project by himself or by more than one employer.

Employer means a person who employs one or more workers or contracts for the services of one or more workers and includes a contractor or subcontractor who undertakes with an owner, constructor, contractor, or subcontractor to perform work or supply services.

Owner includes a trustee, receiver, mortgagee in possession, tenant, lessee, or occupier of any lands or premises used or to be used as a workplace, and a person who acts for or on behalf of an owner as an agent or delegate.

Project means a construction project, whether public or private, including;
(a) the construction of a building, bridge, structure, industrial establishment, mining plant, shaft, tunnel, caisson, trench, excavation, highway, railway, street, runway, parking lot, coffer dam, conduit, sewer, water-main, service connection, telegraph, telephone or electrical cable, pipe line, duct or well, or any combination thereof,

(b) the moving of a building or a structure, and
(c) any work or undertaking, or any lands or appurtenances used in connection with construction.

Supervisor means a person who has charge of a workplace or authority over a worker.

Worker means a person who performs work or supplies services for monetary compensation but does not include an inmate of a correctional institution or like institution or facility who participates inside the institution or facility in a work project or rehabilitation program.

Workplace means any land, premises, location or thing at, upon, in or near which a worker works.

Procedure

For all contracts for services:

- Determine the nature of the work
- Determine the health and safety hazards, and
- Classify the contract work.

a) A construction project that has significant health and safety hazards. Examples would include but are not limited to construction of a community centre, renovations, replacement of a boiler and other major equipment.

b) Maintenance with significant health and safety hazards. Examples would include but are not limited to window washing, annual inspection of roof top anchors, replacement of heating coils, or electrical repairs.

c) No significant health and safety hazards. Examples would include but are not limited to photocopier maintenance and using external training consultants.

For tender contracts it will be the responsibility of the department issuing the tender to obtain the required information from the contractors. For contracts that are not tendered, the City Representative will be responsible for obtaining this information.

For the contracts classified with health and safety hazards, those contractors must be given a copy of the City of Kenora Contractor Safety Program. The contractor must complete the Contractor declaration portion of this document and provide the City's Representative with the required documentation prior to the work commencing.

At the beginning of the work the City's Representative will be responsible to provide the contractor with the appropriate orientation which will include;

- Identification of all known hazards
- A walk through of the work area, and
- Locations of all emergency exits and the procedure for evacuation. (If applicable to the work being performed.)

If at any time a contractor is observed performing work unsafely or contrary to the Act or regulations this must be addressed immediately. The contractor must be made to stop what they are doing and the contractor will not resume the work until such contraventions have been rectified.