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END OF SECTION

Part 1 General

1.1 CONTRACT DOCUMENTS

.1 The Contract Documents are complementary and what is called for on one shall be as binding as if called for by all. The intention of the Contract Documents is to include all labour and material, equipment, superintendence and transportation necessary for the proper performance of the work. Materials or work described in words which so applied have a well-known technical or trade meaning, shall be held to refer to such recognized standards.

Should there be any conflicts in the drawings with the Contract Documents, the Contractor shall notify the Engineer. The Engineer's decision on questions arising under the Contract Documents or the interpretation of the Specifications and Drawings shall govern.

.2 Contract documents are diagrammatic only. They are intended to establish scope, materials and quality; they are not detailed installation drawings. Minor details and incidental accessories required for the proper installation which are not shown or specified are to be included in the work.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

.1 The Contractor shall supply all materials, labour and equipment for construction of the work indicated within these Contract Documents. The following description is intended to provide a general overview and is not to be considered a “scope of work”.

.2 Char Lake Pump House

.1 The general work description for the Char Lake Pump House includes;

.1 A pump house process capable of providing water Signal Hill Water Treatment Plant that meets current potable water standards.

.2 Water for demand equalization, fire-water supply and emergency storage.

.3 Water distribution system to provide required pressure and freeze protection.

.4 Char Lake Pump House building to house, electrical, mechanical and process needs.

.5 Petroleum Impacted Soil and Groundwater Removal from Existing Char Lake Pump House Peninsula

.2 The general work description for the Signal Hill Water Treatment Plant includes;

.1 A water treatment process capable of providing water that meets current potable water standards.

.2 Water storage for demand equalization, fire-water supply and emergency storage.

.3 Water distribution system to provide required pressure and freeze protection.

.4 Water Treatment Plant building to house office, laboratory, electrical, mechanical and process needs.

1.3 OWNER FURNISHED ITEMS

.1 This contract does have some Owner-supplied equipment. Refer to Section 44 01 01 Process Equipment for specific details on the equipment being supplied and further obligations.

.2 Owner Responsibilities:

.1 Arrange for delivery of shop drawings, product data, manufacturer's instructions, and certificates to Contractor.

.2 Deliver supplier's bill of materials to Contractor.

.3 Arrange and pay for delivery to site in accordance with Progress Schedule.

.4 Inspect deliveries jointly with Contractor.

.5 Submit claims for transportation damage.

.6 Arrange for replacement of damaged, defective, or missing items.

.7 Arrange for manufacturer's field services; arrange for and deliver manufacturer's warranties and bonds to Contractor.

.3 Contractor Responsibilities:

.1 Designate submittals and delivery date for each product in progress schedule.

.2 Review shop drawings, product data, and other submittals. Submit to Consultant notification of any observed discrepancies or problems anticipated due to non-conformance with Contract Documents.

.3 Receive and unload products at site.

.4 Inspect deliveries jointly with Owner, record shortages, and damaged or defective items.

.5 Handle products at site, including uncrating and storage.

.6 Protect products from damage, and from exposure to elements.

.7 Assemble, install, connect, adjust, and finish products.

.8 Provide installation inspections required by public authorities.

.9 Repair or replace items damaged by Contractor or Subcontractor on site (under his control). Deliver supplier's bill of materials to Contractor

1.4 QUALITY ASSURANCE

.1 Only tradesmen properly licensed in Nunavut for work requiring special skills shall be employed on such work, and under no circumstances shall any workman or tradesman carry out work for which he has insufficient ability or training.

All materials, fabrication and equipment shall be of reputable manufacturer, and where a product by a manufacturer is noted in the Plans or Specifications, it is to indicate a standard of acceptance for the particular application or approved equal.

1.5 MINIMUM STANDARDS

.1 In the absence of other standards being required by the Contract Documents, all work shall conform to or exceed the minimum standard of the Canadian Government Specification Board, the Canadian Standards Association, or the National Building Code of Canada (latest edition with all current addenda), whichever is applicable.

1.6 DETAIL DRAWINGS AND INSTRUCTIONS

.1 The Engineer shall furnish, as necessary for the performance of the work, additional instructions by means of drawings or other media, which shall be consistent with the Contract Documents and the Contractor shall perform the work in accordance with such instructions.

If either the Contractor or the Engineer so requests, they shall jointly prepare a schedule, fixing the dates at which the various detail drawings will be required, and the Engineer shall furnish them in accordance with this schedule.

1.7 JOB CONFERENCES

.1 Job conferences will be jointly arranged weekly between the Contractor, the Engineer and Government of Nunavut during the progress of the job and when called upon to do so, the job conference shall be attended by an authorized representative of the trade concerned. The Contractor shall furnish accommodation for all the job conferences. Notes shall be typed up afterwards by the Engineer and then circulated to all parties concerned.

.2 The Engineer shall prepare the agenda for the progress meetings and shall be responsible for minuting and circulating the minutes of the meetings to all parties concerned. The agenda for the progress meetings shall include, as a minimum, the following:

.1 Review and acceptance of minutes from previous meeting.

.2 Review of work progress.

.3 Review of planned work prior to next progress meeting.

.4 Construction issues, such as field observations, problems, conflicts which may result in changes to the contract price or construction schedule.

.5 Review of the construction schedule versus actual progress schedules.

.6 Review of contemplated changes notices / contract change orders / field orders and field instructions.

.7 Review of outstanding items from previous meeting.

.8 Date and location of next progress meeting.

.9 Other business.

1.8 PRE-CONSTRUCTION MEETING

.1 Within fifteen (15) days of notification of award of the contract, the engineer shall request a pre-construction meeting. The pre-construction meeting shall be attended by representatives of the Owner/Engineer/Contractor/Major Subcontractors/Project Superintendent (if available) and Engineering Inspector (if available). Upon setting a time and location for the pre-construction meeting the Engineer shall provide all parties seven (7) days notice and shall be responsible for preparing and distributing a pre-construction meeting agenda. The Engineer shall be responsible for the minutes and circulation of these to all parties concerned. The pre-construction meeting agenda shall, as a minimum, include the following:

.1 Introduction of personnel, including roles and contact information.

.2 Contract document status in point form, documents for signing, bonding certificates, certificate of insurance, workers' compensation board clearance certificates and any municipal and government approval certificates required.

.3 Correspondence in point form, reference numbers for the Engineer/Owner and Contractor, personnel for which correspondence is to be addressed.

.4 Notifications:
- Ministry of Labour
- Occupational Health and Safety

.5 Site Supervision Staff, Contractor, Superintendent, Consultants, Site Inspector, Municipal Inspector.

.6. A list of subcontractors.

.7 Documents to be provided by Owner/Engineer.

.8 Materials suppliers.

.9 Material testing requirements, including identification of any laboratory agencies.

.10 Site office.

.11 Projects signed.

.12 Work site diary.

.13 Work Procedures:
- .1 Benchmarks.
- .2 Layout (horizontal and vertical control).
- .3 Temporary storage restoration.
- .4 Water supply.
- .5 Backfill if material needed.
- .6 Service locations and record sheets.
- .7 Dewatering.
- .8 Project closeout.

.14 Disposal of surplus excavated material.

.15 Public relations.

.16 Photographs.

.17 Payment Certificates.

.18 Extra work / change orders.

.19 Weekly site meeting.

.20 Other issues.

1.9 INSPECTOR AND INSPECTION

.1 All work covered under this Contract shall be done to the satisfaction of the Engineer or his Inspector.

.2 The Engineer's Inspector is to ensure that the provisions of the Contract are adhered to. The Inspector shall ensure that the quality of workmanship and materials are to the standards specified in the Contract. The Engineer or his Inspector may stop the work entirely if there is not a sufficient quantity of approved materials on site, or for any reason he deems will adversely affect the quality of work.

.3 All materials and equipment, and their processes of preparation or manufacture, shall be subject to inspection, and testing at all times. If an inspection or a test is failed, the Engineer may reject the affected material or equipment.

The Engineer shall give the Contractor reasonable notice of any inspection or testing he wishes to carry out, except for any inspection or testing specifically stated in the Contract which requires the presence of the Engineer. The Contractor shall be responsible to provide the Engineer at least seven (7) days notice, in writing, to the commencement of the manufacturing or preparation of any materials or equipment which the Contract requires inspection or testing. The Contract shall make all the necessary provisions and provide any assistance required, so that the Engineer can carry out the specified inspection or testing.

If, for any reason, any inspection or testing has not been carried out, the Contractor shall notify the Engineer and any effected material or equipment shall not be delivered to the site of work until authorized by the Engineer, in writing, to do so.

.4 In any event, no materials or equipment required by the Contract or by the Engineer to be inspected or tested by or in the presence of the Engineer shall be incorporated into the work until the required inspection or testing has been carried out to the satisfaction of the Engineer.

.5 The Contractor shall provide, and shall ensure that all Subcontractors and those carrying out the process of preparation or manufacture shall provide, every reasonable facility and cooperation to assist the Engineer or Inspector or others designated by the Contract or by the Engineer in carrying out inspection and testing.

.6 The Contractor shall not backfill or otherwise cover up any work without either having it inspected and passed by the Inspector, or first notifying the Inspector in a manner approved or as directed by the Engineer, that the work is ready to be covered up and allowing the inspector reasonable notice and opportunity for carrying out an inspection.

Any works covered up, other than in accordance to the foregoing, shall be uncovered or opened up as ordered by the Engineer or the Inspector. All subsequent work, either through the inspection and testing or the opening and reinstatement shall be carried out by the Contractor at his expense.

.7 No approval by an Inspector or by the Engineer or failure of an Inspector or the Engineer to carry out an inspection shall relieve the Contractor of his obligations under the Contract or shall be interpreted as being an acceptance of defective or improper work or material.

.8 If, in addition to the inspection provided for above, the Contractor is required by the Contract, by law, by local bylaw or by the Engineer to have any part of the work inspected by others, the Contractor shall give the Engineer and the others concerned reasonable notice of the time and date proposed for the additional inspection.

1.10 LAYING OUT WORK

.1 The Engineer, prior to commencement of the work only, will provide sufficient control points to allow layout by the Contractor. The Engineer shall also set a job benchmark. The Engineer shall advise the Contractor by means of a sketch plan, as to the location of the stakes, benchmarks, and their elevations. The Contractor shall, before commencing the work, satisfy himself as to the meaning and accuracy of the stakes provided by the Engineer.

.2 Unless otherwise specified, all work to be performed under this Contract is to be laid out by the Contractor. He shall employ competent personnel to accurately set out all lines and establish all levels. He shall provide and set in place all necessary batter boards, sight rails, stakes and marks and shall establish bench marks to the satisfaction of the Engineer. The Contractor shall also provide the Engineer with competent assistance required for checking such lines and levels. The Contractor shall be responsible for the accuracy of lines, grades, and levels.

The Contractor shall carefully preserve benchmarks, reference points, and stakes, and in case of willful or careless destruction, he shall be charged with the resulting expense of re-establishment and shall be responsible for any mistake that may be caused by their unnecessary loss or disturbance.

.3 The Contractor shall provide and maintain all necessary watchmen, barriers, fences, warning lights and signs and take all necessary precautions for the protection and safety of workmen and the public. All excavations or obstructions shall be clearly marked between sunset and sunrise with warning flares or lights. Should any of the Contractor's work cause interference with any existing public road, the Contractor shall provide and maintain the necessary detour roads and shall post such signs, warnings and protection as may be required for public convenience and safety.

Prior to the closure of any road or street the Contractor shall notify the following at least one week in advance of the closure, and obtain all appropriate permits:

Municipal Office
Police Department
Fire Department
Public Works Department
Utilities Companies

When the work involves work in streets, the Contractor shall erect at the commencement of the work, and shall maintain during the entire period of such work, portable or other signs, and flagmen when working on major roads, as requested by the Engineer. The Contractor shall provide such number of signs as may be required by the Engineer.

The Contractor shall continuously maintain adequate protection of all work from damage and shall protect the Owner's property from injury or loss arising in connection with this Contract.

He shall make good any damage, injury or loss to his wok and to the property of the Owner, except as per provisions in General Conditions in the Contract Documents, or caused by agents or employees of the Owner. He shall adequately protect private and public property, as provided by law and the Contract Documents.

1.11 CUTTING AND PATCHING

.1 Coordinate all work with other trades.

.2 Coordinate locations and installation of sleeves, inserts and supports with other trades.

.3 Provide sleeves and openings required for mechanical work.

.4 Submit and proposed methods to Engineer and obtain permission prior to any cutting or drilling. This includes drilling for the placement of hanger support rods.

1.12 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.13 CONNECTION TO EXISTING

.1 Maintain liaison with Owner and Engineer regarding interruption of service, re-routing or connection to water system.

.2 Minimize interruption of service arising.

.3 Submit work plan to Engineer and obtain approval prior to any planned interruptions in service. Incorporate procedure described on Drawing M3 into procedure for connection to existing water system.

.4 Notify Fire Department of any planned or accidental interruptions of the water supply to fire hydrants.

.5 Limit any interruptions of to a maximum of three (3) hours.

.6 Determine timing of any interruptions of service with Engineer.

1.14 EXISTING WATER SYSTEM

.1 Contractor to notify the Fire Department, and the City's Department of Public Works of any planned or accidental interruptions of the water supply.

.2 Contractor to notify building occupants or Owner 24 hours in advance of any interruption of their water service.

.3 Interruptions of water service not to exceed three (3) hours and to be confined to the period between 1000 and 1600 h local time unless otherwise authorized.

.4 Planned interruptions which will exceed three (3) hours shall be schedule to occur between 2300 and 0500 h local time otherwise authorized.

1.15 CONTEMPLATED CHANGE NOTICE (CCN)

.1 A Contemplated Change Notice does not constitute a direction to perform the change of works described within. It is solely a notice of a proposed change. Upon receipt of a contemplated change notice, the Contractor shall submit to the Engineer, within the timeframe reference within the document a cost adjustment to the contract associated with the proposed change, as well as any impact that the proposed change will have on the construction schedule. The cost adjustment and scheduled adjustments shall be itemized as required within the Contemplated Change Notice.

1.16 CONTRACT CHANGE ORDER (CCO)

.1 Acceptance of a Contract Change Order by the Owner and the Contractor will constitute a change in the terms, cost and/or schedule of the contract as set forth in the Contract Change Order. The Contract Change Order will be based on a Contemplated Change Order submitted by the Contractor. Contract Change Orders, signed by the Owner and Contractor shall authorize the Contractor to proceed with the change in the scope of work as described with the Contract Change Order.

1.17 FIELD INSTRUCTIONS

.1 Field instructions may be issued during the course of construction as a mechanism to provide clarification to specific items within the Contract or to give additional instructions to the Contractor. Issuance of a field instruction shall not result in any changes to the contract price or the contract schedule.

1.18 FIELD ORDER

.1 Field order may be issued by the Engineer during the course of construction to authorize a change or authorize additional work in an emergency situation where following the process of issuance of a Contemplated Change Notice and Contract Change Notice may result in a delay which could result in damage or injury to life or property or would have an adverse effect on the total cost of the Contract. The field order shall either set a firm cost adjustment for the work or shall include a method for determining the cost of the work (i.e., unit price or cost of labour or material) set forth in the field order.

1.19 RESPONSIBILITY REGARDING EXISTING UTILITIES AND STRUCTURES

.1 The Contractor shall pay for all necessary alterations of any utilities that intersect the line of the proposed work. Excavation in the vicinity of existing structures and utilities shall be carefully performed, and any utilities which cross an excavation must be properly supported or shored to prevent settlement. Where trenching is to be done under existing utilities, such utilities shall be shored before excavation commences and shoring shall be left in place.

The existence, location and elevation of underground utilities are not guaranteed, and notwithstanding any other provision in the Contract, the Contractor shall be responsible for determining the location and elevation of all sewer, water mains, services or lines, electric light, power or telephone conduits, or other such structures or utilities, and shall pay for any service supplied by the Waterworks, Sewer, Electric Light Company or Department, or by any other company or department for the location of utilities and the Contractor shall be responsible for notifying the appropriate company, department, person or persons, of his intention to carry out operations in the vicinity of any such main, line, conduit or other such structure or utility, at least one (1) week in advance of any such operations being there carried out.

The Contractor shall deposit with the Engineer a letter, or letters, from the appropriate authority of the utility or utilities involved stating that the Contractor has made satisfactory arrangements with the utility organization for the location, protection and inspection of the utility involved. He shall be responsible for any costs incurred in the process.

Where utilities are to be moved, the Contractor shall make his own arrangements with the Utility Company or department concerned for the alterations necessary, and will notify the Engineer of all such requirements.

The Contractor shall be responsible for the protection of all survey monuments, posts, and markers. All disturbed monumentation shall be reinstated by the Contractor at his cost by a duly licensed Land Surveyor.

1.20 AIR AND WATER POLLUTION

.1 The attention of the Contractor is called to the Ordinances of Nunavut relating to the pollution of water and air. The Contractor shall carry out his operations in conformity with the applicable sections of the Territorial Ordinances and regulations that are adopted thereto.

1.21 NIGHT WORK

.1 Night work will only be allowed if written permission is given beforehand by the Engineer. When any work is carried out at night, the Contractor shall supply at his own cost a sufficient number of electric or other approved and efficient lights to enable the work to be done in an efficient and satisfactory manner. Permission of the Engineer does not relieve the Contractor of the responsibility for obtaining necessary permission from local governing agencies.

1.22 SUBMITTALS

.1 General:

.1 In accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide shop drawings and product data for all materials stipulated in the specifications or drawings.

.3 Submit four (4) prints of submittals for each requirement requested in specification Sections and as the Engineer may reasonably request.

.4 Submit to Engineer submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in work.

.5 Work affected by the submittal shall not proceed until review is complete.

.6 Review submittals prior to submission to the Engineer. Submittals not stamped, signed, dated, and identified by the Contractor will be returned without being examined and shall be considered rejected.

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

.2 Shop Drawings and Product Data:

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

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

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

.4 Submit four (4) prints of shop drawings for each requirement requested in specification Sections and as the Engineer may reasonably request.

.5 Submit four (4) copies of product data sheets or brochures for requirements requested in specification Sections and as the Engineer may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.

.3 Closeout Submittals:

.1 Operation and Maintenance Manual approved by, and final copies deposited with Engineer 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 Approvals:

.1 Submit two (2) copies of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless directed by Engineer.

.2 Make changes as required and re-submit.

.5 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.6 Site records:

.1 Engineer will provide set of reproducible mechanical drawings and electronic copy of mechanical drawing. Maintain white prints. Mark changes as work progresses and as changes occur.

.2 Transfer information weekly to reproducible and electronic drawings to show work as actually installed.

.3 Make available for reference purposes and inspection.

.7 As-built drawings:

.1 Prior to start of testing 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 Engineer for approval and make corrections as directed.

.4 Submit completed reproducible and electronic as-built drawings with Operating and Maintenance Manuals.

1.23 SAMPLES

.1 The Contractor shall furnish for the Engineer's approval all samples required by the Contract or as requested by the Engineer. The work shall be in accordance with the approved samples.

1.24 "OR EQUAL" MATERIALS

.1 Any place in the Drawings or Specifications where "or equal" is specified, the "or equal" shall be submitted to, and be approved by the Engineer in writing. Detailed plans and

specifications of the alternate materials shall be submitted to the office of the Engineer, and unless written permission is given for their use, they will not be considered for this Contract.

In the submission of alternatives or equals to items of material mentioned in the Specifications, the Contractor shall in his Tender make consideration for any changes required in the works to accommodate such alternatives or equals. A claim by the Contractor for an addition to the contract sum because of changes in work necessitated by the use of alternatives or equals will not be considered.

1.25 ALTERNATIVE MATERIALS

.1 The contract price shall be based on the materials specified within the contract documents.

.2 Approval of alternate materials submitted by the Contractor or his Subcontractor as equal to that specified does not relieve the Contractor of any responsibility.

.3 Revisions required to allow the use of accepted alternates shall be at the Contractor's expense. No increase in the contract price will be considered to accommodate the use of materials or products other than those specified.

1.26 CLEANING AND DISINFECTION

.1 Flush and disinfect all piping prior to placing into service.

.2 Disinfect piping to AWWA C651-05.

.3 Flush piping to remove disinfection solution following disinfection.

.4 Test chlorine concentration during disinfection. Conduct bacteriological testing following disinfection and flushing. Provide test results to Engineer. Provide additional flushing and disinfection of test results unsatisfactory.

.5 Engineer to witness disinfection and flushing. Provide four (4) days notice in advance of disinfection.

1.27 RECORD DRAWINGS

.1 A set of drawings and specifications recording the changes and deviations are to be maintained on site, and updated daily.

.2 A set of final record drawings is to be submitted to the Engineer within two (2) weeks of completion and acceptance of the work. Failure to maintain and submit the record drawing, requiring the work to be carried out by other will be at the contractor's expense.

.3 A copy of the drawings and specifications for the purpose of maintain the record drawings, will be provided by the Engineer.

1.28 SUBSTANTIAL COMPLETION INSPECTION

.1 The Engineer is to be advised a minimum of five (5) day in advance of the desired date for the Substantial Completion Inspection.

.2 It is the Contractor's responsibility to ensure all systems are operational prior to the inspection, and that the work is substantially complete. The Contractor shall be responsible for any expenses resulting for the work not being functional or substantially complete resulting in the requirement for a subsequent Substantial Completion Inspection, including the Engineer's and Owner's time and expenses.

.3 All deficiencies noted in the Substantial Completion Inspection shall be addressed in a timely manner, normally within two (2) weeks unless otherwise specified within the Certificate of Substantial Completion.

1.29 SANITARY REGULATIONS

.1 The Contractor shall prohibit and prevent the committing of nuisance on the site of the work or on adjoining property, and shall discharge any employee who commits a nuisance.

.2 The Contractor is to provide a toilet on site.

1.30 ABBREVIATION REFERENCES

.1 Reference to technical society, organization or body is made in the Specifications in accordance with the following abbreviations:

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ARCA	Alberta Roofing Contractors Association
ASA	American Standards Association
ASTM	American Society for Testing Materials
AWI	Architectural Woodwork Institute
AWSC	American Welding Society Code
BCLMA	British Columbia Lumber Manufacturer's Association
CBURA	Calgary Built-Up Roofers Association
CCA	Canadian Construction Association
CISC	Canadian Institute of Steel Construction
CITC	Canadian Institute of Timber Construction
CGSB	Canadian Government Specifications Bureau
CLA	Canadian Lumberman's Association
CRCA	Canadian Roofing Contractor's Association
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CWB	Canadian Welding Bureau
CUA	Canadian Underwriters Association
API	American Petroleum Association
AWWA	American Water Works Association
ASME	American Society of Mechanical Engineers
MTTAC	Marble, Tile and Terrazzo Association

NBC	National Building Code (Canada) 1980
NRC	National Research Council (Canadian)
RAIC	Royal Architectural Institute of Canada
UL	Underwriter's Laboratories, Inc. (Canada)
CEC	Canadian Electrical Code

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 32 11 10 – Aggregates General

.2 Section 32 25 00 – Roadway

1.2 SCHEDULE OF WORK

.1 The Contractor within seven (7) days of the notice of award of this contract shall submit to the Engineer a proposed final schedule in the form of a bar chart for his approval. The schedule shall include proposed dates for commencement and completion of each of the tasks required under this contract. The tasks will include, but will not be limited to, all manufacturing, preparation, shipping, and the installation of the items in this contract. The schedule will also include the anticipated dates for all testing, commissioning, and inspections as required elsewhere in this contract. The Contractor will also provide all necessary and appropriate information and any other information deemed pertinent by the Engineer regarding sequence and co-ordination which will be required to ensure successful completion of the project.

.2 If the Contractor fails to adhere to the approved progress schedule, he must promptly adopt such other or additional means and methods of construction that will make up for the time lost and will assure completion in accordance with such schedule.

.3 If at any time the Engineer determines the work, tools, plant or equipment to be insufficient, inefficient or inappropriate, the Contractor shall take whatever action required to right the situation. The failure of the Engineer to instruct the Contractor to make such changes does not relieve the Contractor of his obligation to ensure the quality of work and rate of progress to complete the work as required.

1.3 REFERENCES

.1 ASTM International

.1 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft;) (600kN-m/m;).

1.4 MATERIALS LIST

.1 Within three (3) days of the notice of award of this contract, the Contractor shall provide a complete list of suppliers for the materials required for this contract. The list will include the supplier's name, a contact person, phone number, and address where applicable.

.2 The Contractor will provide verification for the Engineer that all equipment specified by make and model number has been supplied as specified. No equipment shall be installed prior to written approval given by the Engineer. No material will be paid for without having received the Engineer's approval.

1.5 ORAL ARRANGEMENTS

.1 In all cases of misunderstandings or disputes, oral arrangements will not be considered. The Contractor must produce written authority in support of his contentions, and shall not advance any claim against the Owner or its representatives in the absence of such written authority.

1.6 PROJECT IDENTIFICATION SIGN

.1 The Contractor shall supply and erect a fabricated sign at the location designated by the Engineer. The sign is to be fabricated to the dimension and details as specified below on the detail sheet at the end of this section and provide suitable stable framework to support the sign.

.2 Plywood to be 20 mm exterior grade GIS. Lettering style Helvetica with background colour white.

.3 All exterior signs placed on buildings or facilities that house offices of the government of Nunavut should appear in Inuktitut, Inuinnaqtun, English and French. All languages should be equally prominent per the Government of Nunavut language services guidelines.

.4 Supports to be 3 - 15 cm x 15 cm spruce mounted 30 cm from each side and centre extending from the top of the sign. The bottom of the sign to be mounted 2 metres above the ground with supports embedded 1.5 metres into the ground.

.5 Sign to be supplied complete with all supports, hardware, and other necessary materials.

1.7 MEASUREMENT AND PAYMENT

.1 General

.1 The whole of the work shall be by a "Unit Price Basis" as defined in the Form of Tender.

.2 Payment shall not be made for work requiring an inspection certificate until the certificate has been issued by the Engineer.

.3 All costs necessary to complete work as specified and shown on the drawings shall be allowed for in the unit prices tendered. Where an item of work is not shown in the Schedule of Prices, the cost of the item of work shall be included with the most appropriate item of work listed in the Tender Form.

.4 The work descriptions given in the following clauses do not necessarily describe the work in complete detail. Work not specifically included shall be allowed for as required above.

.5 For the purposes of this contract supply and delivery will be paid once materials have been delivered to the Contractor's storage area in Resolute Bay outside of the shipping compound. In addition, an itemized list will be presented to the Engineer and the materials inspected prior to any payment being made in the form of a manifest.

.2 Mobilization, Demobilization and Temporary Communication Factitive

.1 50% of the unit price tendered will be paid for mobilization upon confirmation by the Engineer that the Contractor has delivered the necessary plant, equipment, labour, and material to complete the work as outlined in the contract documents.

.2 30% of the unit price tendered will be retained for demobilization, which will be paid upon successful commissioning of the new installation, and cleanup of the site.

.3 10% of the unit price tendered for this item will be paid upon completion of the erection of the project sign as described in these documents.

.4 10% of the unit price for this item will be paid once site cleanup and restoration has been accepted.

.3 Supply and Delivery

.1 The unit price tendered shall include all labour, equipment and materials for the fabrication and/or procurement of the materials specified, and the delivery of the materials to Resolute Bay.

.2 Payment will be based on the units and estimated quantities as listed in the Form of Tender.

.4 Site Work:

.1 The unit price tendered shall include all labour, equipment and materials necessary to compete the work , including but not limited to connection to exist. Water line, new intake piping , new pumps , grading of site and new access road.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

.5 Demolition and Removal of Existing Water Pump Station and Water Treatment Plant Supply

.1 The unit price tendered shall include all labour, equipment and materials necessary to demolish and remove off site of existing building materials after removing and salvaging existing equipment and re-useable components.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

.6 Water Treatment Plant

<u>Substructure Construction</u>:

.1 The unit price tendered shall include the supply and delivery of all equipment, labour, and material necessary to build all components of the substructure, Including but not limited to all piling work.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

Superstructure (Architectural, Structural):

.1 The unit price tendered shall include the supply and delivery of all equipment, labour, and material necessary to build all components of the superstructure, Including but not limited to Architectural, Structural components.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

Process and Mechanical Work and Equipment:

.1 The unit price tendered shall include the supply and delivery of all equipment, labour, and material necessary to build all components of the process and mechanical systems, Including but not limited to all Process and Mechanical equipments and components.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

Electrical, Instrumentation and Control:

.1 The unit price tendered shall include the supply and delivery of all equipment, labour, and material necessary to build all components of the electrical, instrumentation and electrical systems, Including but not limited to all equipments and components.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

.7 New Char Lake Pump House

Substructure Construction:

.1 The unit price tendered shall include the supply and delivery of all equipment, labour, and material necessary to build all components of the substructure, Including but not limited to all piling work.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

Superstructure (Architectural, Structural):

.1 The unit price tendered shall include the supply and delivery of all equipment, labour, and material necessary to build all components of the superstructure, Including but not limited to Architectural, Structural components.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

Process and Mechanical Work and Equipment:

.1 The unit price tendered shall include the supply and delivery of all equipment, labour, and material necessary to build all components of the process and mechanical systems, Including but not limited to all Process and Mechanical equipments and components.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

Electrical, Instrumentation and Control:

.1 The unit price tendered shall include the supply and delivery of all equipment, labour, and material necessary to build all components of the electrical, instrumentation and electrical systems, Including but not limited to all equipments and components.

.2 Payments will be made on basis of percentage of completion of the Item as estimated by the Engineer.

.8 Petroleum Impacted Soil and Groundwater Removal from Existing Char Lake Pump House Peninsula

Soil Removal:

.1 The unit price tendered shall include all labour, equipment, materials, shipping fees, and tipping fees required to excavate, package for shipping, ship, ground transport and dispose of up to 750 m^3 of petroleum hydrocarbon contaminated soil at a licensed soil remediation facility willing to accept it.

.2 The unit price tendered shall include all labour, equipment, shipping fees, and analytical laboratory fees for collection and analyses of confirmatory soil samples needed to ensure all petroleum hydrocarbon impacted soil has been removed from the existing pump house peninsula.

Groundwater Pumping and Treatment:

.1 The unit price tendered shall include all labour, equipment, and materials required to treat and discharge, to an Engineer-approved location down-gradient of Char Lake, petroleum hydrocarbon impacted groundwater from the soil removal excavation(s). The Contractor should have a portable water treatment system consisting of, as a minimum, particulate filtration and granular activated carbon vessels of suitable size, in place at the time of the site remedial activities. The Contractor should also have a holding tank for the treated groundwater of sufficient size to allow for multiple days of storage pending confirmatory analytical laboratory testing of stored water. The Contractor should also have a minimum of 250 m of discharge hose for the treatment system, as well as erosion control materials to ensure the treated water does not re-enter Char Lake or cause the erosion of the ground surface at the discharge location.

.2 The unit price tendered shall include all labour, equipment, shipping fees, and analytical laboratory fees for collection and analyses of confirmatory water samples needed to ensure groundwater treatment system is removing all petroleum hydrocarbon contamination from groundwater prior to discharge to the environment.

Site Restoration:

.1 The unit price tendered shall include all labour, equipment, and materials necessary to restore the existing Char Lake Pump House peninsula to original grade following the removal of the petroleum hydrocarbon impacted soil materials.

.9 Rock Excavation and Disposal Off–Site

.1 The unit price tendered shall include all equipment, labour and materials necessary for the excavation, transportation, and disposal off- site of the excavated rock material. This is inclusive of all requirements for drilling, blasting, cover material, loading, hauling, placing and spreading of the material at a site specified by the Engineer.

.2 Payment shall be based on the measured cubic metre of rock material excavated. For rock removed within a utility trench, the volume measured shall be based on the minimum trench width.

.10 Sub excavation of Unsuitable Material

.1 The unit price tendered shall include all labour, equipment, and materials required to excavate and dispose of together with the replacement of the material for excavation below the specified lines of the trench as requested by the Engineer. The measurement of payment shall be on the cubic meter of excavation as determined by the Engineer through sections taken in the field.

.2 Payment should be made only for quantities ordered by the Engineer with the restriction that no payment shall be made for quantities even when ordered by the Engineer which became necessary due to the contractor's failure to keep the trench free of water, melting snow, ice and/or ice rich soil.

Part 2 Products

Not Used

END OF SECTION

Part 1 General

1.1 CASH ALLOWANCES

.1 Include in Contract Price all cash allowances.

.2 Cash allowances, unless otherwise specified, cover net cost to of service provided.

.3 Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.

.4 Where costs under a cash allowance exceed amount of allowance, contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.

.5 Submit evidence of costs in connection with cash allowances as the Engineer may require.

.6 Amount of each allowance, for Work specified in respective specification Sections is as follows:

.1 Include allowance of $40,000.00 for the supply and installation of:

.1 A new electrical service from Nunavut Power Corporation.

.2 A new telephone service from NorthwestTel.

1.2 CONTINGENCY ALLOWANCE

Not Used

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 This refers to all related sections.

1.2 SECTION INCLUDES

.1 Shop drawings and product data.

.2 Samples.

.3 Certificates and transcripts.

1.3 ADMINISTRATIVE

.1 Submit to Engineer submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in 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 Work affected by submittal shall not proceed until review is complete.

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

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

.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 requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.

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

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

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

1.4 SHOP DRAWINGS AND PRODUCT DATA

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

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, 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 Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.3 Allow ten (10) days for Engineer's review of each submission.

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

.5 Make 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.

.6 Accompany submissions with transmittal letter, in duplicate, containing:

- .1 Date
- .2 Project title and number
- .3 Contractor's name and address
- .4 Identification and quantity of each shop drawing, product data and sample
- .5 Other pertinent data

.7 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 Contractor's 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

.8 After Engineer's review, distribute copies.

.9 Submit seven (7) prints of shop drawings for each requirement requested in specification Sections and as Engineer may reasonably request.

.10 Submit seven (7) hard copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Engineer where shop drawings will not be prepared due to standardized manufacture of product.

.11 Delete information not applicable to project.

.12 Supplement standard information to provide details applicable to project.

.13 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

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

1.5 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

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

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

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Adjustments made on samples by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.

.6 Make changes in samples which Engineer may require, consistent with Contract Documents.

.7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.6 PROGRESS PHOTOGRAPHS

.1 Submit progress photographs.

1.7 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 05 50 00 - Metal Fabrications

.2 Section 23 37 13 - Diffusers, Registers and Grilles

1.2 REFERENCES

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.3 Northwest Territories and Nunavut:

.1 Safety Act, R.S.N.W.T. 1998, or latest edition.

1.3 SUBMITTALS

.1 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.1 Results of site specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operations found in work plan.

.2 Submit three (3) copies of Contractor's authorized representative's work site health and safety inspection reports to Engineer weekly.

.3 Submit copies of reports or directions issued by Federal and Territorial health and safety inspectors.

.4 Submit copies of incident and accident reports.

.5 Submit WHMIS Material Safety Data Sheets (MSDS) to Engineer.

.6 Engineer will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within seven (7) days after receipt of plan. Revise plan as appropriate and resubmit plan to Engineer within seven (7) days after receipt of comments from Engineer.

.7 Engineer's review of Contractor's final Health and Safety Plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.8 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Engineer.

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

1.4 FILING OF NOTICE

.1 File Notice of Project with Territorial authorities prior to beginning of Work.

1.5 SAFETY ASSESSMENT

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

1.6 MEETINGS

.1 Schedule and administer Health and Safety meeting with Engineer prior to commencement of Work.

1.7 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site work and continue to implement, maintain, and enforce Plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Engineer may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.8 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 Plan.

1.9 COMPLIANCE REQUIREMENTS

.1 Comply with Safety Act, General Safety Regulations, R.R.N.W.T. 1998.

.2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.10 UNFORESEEN HAZARDS

.1 When an unforeseen or peculiar safety-related factor, hazard, or condition occurs during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Territory having jurisdiction and advise Engineer verbally and in writing.

1.11 HEALTH AND SAFETY COORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:

.1 Have minimum two (2) years' site related working experience specific to activities associated with similar work.

.2 Have working knowledge of Occupational Safety and Health Regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.5 Be on site during execution of Work.

1.12 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 the Territory having jurisdiction, and in consultation with the Engineer.

1.13 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by the Engineer.

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

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

1.14 BLASTING

.1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Engineer.

1.15 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from Engineer.

1.16 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.

Part 2 Products

Not used

Part 3 Execution

Not used

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 35 20 – Health and Safety Requirements

1.2 REFERENCES

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.3 Northwest Territories and Nunavut:

.1 Safety Act, R.S.N.W.T. 1998, or latest edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit site-specific Health and Safety Plan, within [7] days after date of Notice to Proceed and prior to mobilization to site. Address following items:

.3 Safety and health risk or hazard analysis for each site task and operation [found in work plan].

.4 Develop checklist for items to be inspected on a daily basis. Document actions taken.

.5 Personnel training requirements including:

.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, medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards, and elements of site-specific Health and Safety Plan.

.6 Personal protective equipment (PPE) program addressing:

.1 Donning and doffing procedures.

.2 PPE selection based upon site hazards.

.3 PPE use and limitations of equipment.

.4 Work mission duration, PPE maintenance and storage.

.5 PPE decontamination and disposal.

.6 PPE inspection procedures prior to, during, and after use.

.7 Evaluation of effectiveness of PPE program, and limitations during temperature extremes, and other appropriate medical considerations.

.8 Medical surveillance requirements for personnel assigned to work at site.

.9 Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment.

.10 Site control measures 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.

.11 Decontamination procedures for both personnel and equipment.

.12 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, decontamination procedures not covered under decontamination section, emergency medical treatment and first aid, emergency alerting and response procedures, critique of response and follow-up, PPE and emergency equipment, site topography, layout, prevailing weather conditions, and procedures for reporting incidents to local, provincial, or federal agencies.

.13 Written respiratory protection program for project activities.

.14 Procedures dealing with heat and/or cold stress.

.15 Confined space entry procedures.

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

.7 Consultant will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Consultant within 7 days after receipt of comments from Consultant.

.8 Medical Surveillance: submit certification of medical surveillance for site personnel, within 7 days after date of Notice to Proceed and prior to mobilization to site. Submit additional certifications as personnel are sent to site.

.9 Respirator Fit Testing: submit proof of respirator fit testing for site personnel, within 7 days after date of Notice to Proceed and prior to mobilization to site.

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

.1 Prior to commencing Work involving handling of hazardous materials, develop on-site Contingency and Emergency Response Plan.

.2 Plan must provide immediate response to serious site occurrence such as explosion, fire, or migration of significant quantities of toxic or hazardous material from site.

.11 Off-site Contingency and Emergency Response Plan:

.1 Prior to commencing Work involving handling of hazardous materials, develop off-site Contingency and Emergency Response Plan.

.2 Plan must provide immediate response to serious site occurrence such as explosion, fire, or migration of significant quantities of toxic or hazardous material from site.

1.4 REGULATORY REQUIREMENTS

.1 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.

1.5 SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Furnace oil/diesel impacted soil and groundwater.

1.6 GENERAL REQUIREMENTS

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

.2 Ensure Health and Safety guidelines provide for safe and minimal risk working environment for site personnel and minimize impact of activities involving contact with hazardous materials or hazardous wastes on general public and surrounding environment.

1.7 RESPONSIBILITY

.1 Be responsible for safety of persons and property on site and for protection of persons off 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, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.8 HAZARD COMMUNICATION REQUIREMENTS

.1 Comply with Work Site Hazardous Materials Information System Regulations, R.R.N.W.T.

.2 Comply with Occupational Health and Safety Regulations, Part XXII Controlled Products - Workplace Hazardous Materials Information System.

.3 Comply with Workplace Hazardous Materials Information System (WHMIS) Regulations, O.I.C.

.4 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations, Part X - Hazardous Substances.

.5 Provide Consultant with Material Safety Data Sheets (MSDS) and documentation on any "hazardous" chemical that Contractor or Contractor Representatives plan to bring onto site.

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 Assign responsibility and obligation to Health and Safety Officer where required to stop or start Work when, at Health and Safety Officer's discretion, it is necessary or advisable for reasons of health or safety. [Departmental Representative] [DCC Representative] [Consultant] may also stop Work for health and safety considerations.

1.10 UNFORESEEN HAZARDS

.1 Should unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, stop work and immediately advise Consultant verbally and in writing.

1.11 PERSONNEL HEALTH, SAFETY, AND HYGIENE

.1 Medical Surveillance:

.1 Conduct medical surveillance of personnel as required by specified regulations.

.2 Training: ensure personnel entering site are trained in accordance with specified personnel training requirements. Training session must be completed by Health and Safety Officer.

.3 Levels of Protection: establish levels of protection for each Work area based on planned activity and location of activity. Minimum PPE required for each level of protection as follows:

.4 Level D:

.1 Head, Eye, Ear Protection: hard hat, safety glasses with sideshields, and ear muffs or plugs.

.2 Clothing: standard work uniform including safety boots, reflective clothing, and gloves.

.5 Personal Protective Equipment:

.1 Furnish site personnel with appropriate PPE as specified above. Ensure that safety equipment and protective clothing is kept clean and maintained.

.6 Heat Stress/Cold Stress: implement heat stress and/or cold stress monitoring program as applicable and include in site-specific Health and Safety Plan.

.7 Personnel Hygiene and Personnel Decontamination Procedures. Provide minimum as follows:

.1 Suitable containers for storage and disposal of used disposable PPE.

.2 Potable water and suitable sanitation facility.

.8 Emergency and First-Aid Equipment:

.1 Locate and maintain emergency and first-aid equipment in appropriate location on site including first-aid kit to accommodate number of site personnel; portable emergency eye wash; two 9 kg ABC type dry chemical fire extinguishers.

.2 As minimum, provide 1 certified first-aid technician on site at all times when work activities are in progress.

.9 Site Communications:

.1 Post emergency numbers near site telephones.

.2 Ensure personnel use of "buddy" system and develop hand signal system appropriate for site activities.

.3 Provide employee alarm system to notify employees of site emergency situations or to stop Work activities if necessary.

.4 Furnish selected personnel with 2-way radios.

.5 Safety Meetings: conduct mandatory daily safety meetings for personnel, and additionally as required by special or work-related conditions; include refresher training for existing equipment and protocols, review ongoing safety issues and protocols, and examine new site conditions as encountered. Hold additional safety meetings on as-needed basis.

.10 Custodian: employ and assign to Work Custodian to report directly to Health and Safety Officer and who is responsible for keeping safety equipment and facilities clean, properly equipped, and maintained. Custodian may perform other duties for Contractor but Custodian's first priority is maintenance of protective equipment and personnel decontamination area.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Carry out work so that adverse effects on natural environment are minimized.

.2 Ensure personnel are suitably instructed regarding environmental protection requirements applicable to this work.

1.2 FIRES

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

1.3 DRAINAGE

.1 Provide temporary drainage and pumping required to keep excavations and site free from water.

.2 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.

.3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.4 WORK ADJACENT TO WATERWAYS

.1 Do not operate construction equipment in waterways. Construction equipment is to be operated on land only.

.2 Do not use waterway beds for borrow material

.3 Waterways are to be free of excavated fill, waste material and debris.

.4 Design and construct temporary crossings to minimize erosion to waterways.

1.5 POLLUTION CONTROL

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

.2 Control emissions from equipment and plant to local authorities' emission requirements.

.3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.6 INSPECTIONS

.1 The project site(s), from time to time, may be inspected to ensure compliance with Federal, Territorial, and Local environmental requirements.

Part 2 Products

Not Used.

Part 3 Execution

Not Used.

END OF SECTION

Part 1 General.

1.1 SECTION INCLUDES

.1 Project meetings.

.2 Project coordination.

.3 Cutting and patching.

.4 Field engineering.

.5 Identification systems.

1.2 MEETINGS

.1 Schedule and administer project meetings throughout the progress of the work at the call of the Engineer. Meetings shall be held at least bi-weekly and if deemed necessary by the Engineer weekly.

.2 Provide physical space and make arrangements for meetings.

.3 Record the minutes. Reproduce and distribute copies of minutes within three (3) days after each meeting and transmit to meeting participants.

.4 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.5 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.

.6 Contractor, major Subcontractors involved in work, Engineer and Owner are to be in attendance.

.7 The Contractor shall schedule separate meetings for day to day subtrade coordination.

1.3 COORDINATION

.1 Allocate mobilization areas of site: for field offices and sheds, access, traffic, and parking facilities.

.2 During construction coordinate use of site and facilities through procedures for submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.3 The Contractor and the subtrades shall prepare coordination drawings. Review and approve revised drawings for submission to Engineer.

.4 Mechanical and Electrical Coordinator: The Contractor shall be responsible for all coordination of mechanical and electrical work required for this Project, for duration of construction work.

1.4 FIELD ENGINEERING

.1 Qualified registered land surveyor, acceptable to Owner.

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

.3 Report to Engineer when a reference point is lost or destroyed, or requires relocation because of necessary changes in grades or location.

.4 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.

.5 Establish lines and levels, locate and lay out, by instrumentation.

.6 On completion of foundation, prepare a certified survey showing dimensions, locations, angles and elevations of work.

1.5 IDENTIFICATION SYSTEMS

.1 Submit two (2) typed copies of schedules for nameplates and valve tags 15 days prior to inspection for Substantial Performance or five (5) days prior to date scheduled for instruction of Owner's personnel.

.2 Nameplate schedules shall list: Pump, control, and electrical equipment nameplates.

.3 Include nameplate designation, manufacturer's nameplate data, equipment and component parts; numbers, location of equipment, and switch location and normal operating position of switch.

.4 Valve tag schedules shall list each tag by system. Include reference number, valve location and usage, system identification, colour code, and function, size and valve manufacturer with model number, and normal operating position of valve.

Part 2 Products

Not Used.

Part 3 Execution

Not Used.

END OF SECTION

Part 1 General

1.1 PERMITS/INSPECTIONS

.1 The Contractor shall obtain and pay for all permits, licences, certificates and government inspections required for the performance of the Work in force at the Tender closing date. Renew all permits, licences, certificates and inspections required for each phase of the work, as required for each construction year. Submit copies of all permits, licences, certificates and inspection reports to the Engineer, prior to the beginning of work each year.

.2 Give all required notices and comply with all local, territorial and federal laws, ordinances, rules, regulations, codes and orders relating to the Work, which are or become in force during the performance of the work.

1.2 APPLICABLE CODES/STANDARDS

.1 Where specified codes/standards are not dated, conform to latest issue of specified codes/standards as amended and revised to the Tender closing date.

.2 Confine apparatus, the storage of products and the operations of workers to limits indicted by laws, ordinances, permits and by directions of the Engineer. Do not unreasonably encumber the premises with products.

1.3 SAFETY

.1 Observe and enforce all construction safety measures required by code, Workers' Compensation Board, the Territorial Safety Act and all applicable statues. Appoint a suitably qualified employee who has sole responsibility on site on behalf of the Contractor, for compliance with the requirements and so advise the Owner in writing with a copy to the Engineer.

.2 In the event of discrepancy between such provisions, the most stringent provision shall apply.

.3 Employ a qualified specialty Engineer, registered in Nunavut, for the design of all shoring and falsework for the temporary supports of all structural elements, earth blanks, road, etc.

.4 Make available two (2) "Visitor Safety Helmets" for authorized workers.

.5 Burning of refuse will not be permitted.

.6 If "NO SMOKING" regulations are in effect in area of the Work, ensure that all workers comply with the regulations.

.7 Ensure that all workers comply with the Owner's safety regulations where such regulations are in effect.

1.4 CLEANING OF STREETS

.1 Conform to local ordinances and by-laws relating to littering of streets.

.2 Take precautions to prevent depositing mud or debris on public or private roadways adjacent to the Work. Clean up immediately; otherwise the Engineer will direct necessary cleanup with all costs back-charged to the Contractor.

1.5 WORKING LIMITS/TEMPORARY EASEMENTS

.1 Confine all operations within the Owner's property limits.

.2 Arrange for encroachment on areas beyond property lines separately with the property owners.

.3 Obtain consent of adjoining property owners regarding need for any temporary easements or any other encroachments. Upon completion of contract, make good any damage to adjacent property.

1.6 TAXES/DUTIES/PATENTS

.1 Provincial Sales Tax

.1 Exclude applicable sales taxes from the Tender Price.

.2 Goods and Services Tax

.1 This project is not GST exempt. The GST paid to the Contractor will show on the payment certificates as a separate item.

.3 Customs Duties

.1 Include custom duties in the Tender Price.

.2 Exemption Certificates, or such other documents which would permit purchase of goods exempt of customs duties, will be considered by the Owner if they apply, only after award of Contract.

.4 Exemptions

.1 Where an exemption or refund of GST, PST, customs duty or excise tax is applicable to the Contract, cooperate fully with the Owner and the authorities to obtain such exemption or refund.

.2 Where government regulations permit, during the performance of the Contract, the Owner will make applications for refunds of tax on items of equipment and materials for which a tax exemption is allowed.

.3 Provide the Owner with copies of invoices for all such equipment and materials which are incorporated into the Work. Submit copies of such invoices with progress claims at the earliest opportunity. Submit invoice copies serially numbered; maintain a list of the goods covered by each invoice as they become incorporated in the Work. The list is to be updated and submitted with each progress claim.

.5 Patent Fees

.1 Pay all royalties and patent licence fees required for the performance of the Contract. Hold the Owner harmless from and against all claims, demands, losses, costs, damages, actions, suits or proceedings arising out of the performance of

the Contract which are attributable to an infringement or an alleged infringement of any patent or invention by the Contractor or anyone for whose act the Contractor may be liable.

.2 The Owner shall hold the Contractor harmless against all claims, demands, losses, costs, damages, actions, suits or proceedings arising out of the performance of the Contract which are attributable to an infringement or an alleged infringement of any patent or invention in executing anything for the purpose of the Contract, the model, plan or design of which was supplied by the Owner.

1.7 EXISTING UTILITIES

.1 Notify the Hamlet a minimum of one (1) week in advance of commencing the work.

.2 Indemnify and save harmless the Owner or existing utilities for any loss or damage which may be suffered by reason of the operations of the Contractor in the performance of the Contract.

END OF SECTION

Part 1 General

1.1 INSPECTION

.1 Allow the Owner and the Engineer access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Engineer's 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.

.4 The Engineer may order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, the Owner shall pay cost of examination and replacement.

1.2 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Owner 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 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Engineer at no cost to the Owner. Pay costs for retesting and re-inspection.

1.3 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, as well as offsite manufacturing and fabrication plants.

.2 Cooperate to provide reasonable facilities for such access.

1.4 PROCEDURES

.1 Notify appropriate agency and Engineer in advance of 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 orderly sequence to not cause delays in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.5 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Engineer as failing to conform to the Contract Documents. Replace or re-execute in accordance with Contract Documents at no extra cost to the Owner.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If, in the opinion of the Engineer, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the Owner may deduct from Contract Price the difference in value between Work performed and that called for by the Contract Documents, the amount of which shall be determined by the Engineer.

1.6 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as may be requested or specified.

.2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by the Engineer and may be authorized as recoverable.

1.7 MILL TESTS

.1 Submit mill test certificates as requested.

1.8 EQUIPMENT AND SYSTEMS

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 33 11 16 – Water Mains

1.2 SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.4 DEWATERING

.1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

1.5 TEMPORARY WATER SUPPLY

.1 The Contractor will provide a continuous supply of potable water to all affected residents during the construction period.

.2 This temporary water service will remain in effect until the new watermain is accepted by the Engineer.

.3 Connections to the existing system are to be included in the unit price

1.6 TEMPORARY COMMUNICATION FACILITIES

Under this tender item, the Contractor shall supply and maintain a field office and its associated items for the sole use of the Contractor Administrator and staff.

.1 Location

.1 Prior to the commencement of work on this tender item, the Contractor shall receive approval from the Contract Administrator for the location of the field office, and shall have the field office installed and operational.

.2 Field Office Dimensions and Condition

.1 The field office shall have a minimum floor area as specified in the Schedule of Prices. It shall have an inside minimum clearance of two (2) meters.

.2 All doors shall be solid and capable of being locked with a 25 mm throw dead bolt lock, and two sets of keys will be supplied to the Contract Administrator.

.3 The inside of the field office shall be moisture tight and capable of being lit to a level that is satisfactory to the Contract Administrator. It shall have adequate

windows, heating and ventilating equipment capable of maintaining the working area at 21°C.

.3 Field Office Equipment

.1 The Contractor shall supply for the sole use of the Contract Administrator the following furnishings for the appropriate trailer size.

Floor Area 20-34 m^2

1 desk
2 drafting tables (2 m^2 ea.)
1 lockable filing cabinet (3 drawer)
2 stools
2 chairs

1 telephone and internet hookup

.2 The Contractor shall supply or arrange to supply a water cooler capable of maintaining a water supply at 7°C. Water shall be potable and supplied at a rate dictated by the Contract Administrator.

.4 Utilities and Sanitary Facilities

.1 The Contractor shall provide within the floor area of the field office a working telephone hydro facilities for the sole use of the Contract Administrator.

.2 It is the responsibility of the Contractor to provide and maintain adequate sanitary facilities for the exclusive use by the Owner's staff and its Consultants.

1.7 MEASUREMENT FOR PAYMENT

.1 Payment for the supply of a field office, its utilities, services and associated equipment shall be as stated in Section 10 12 50 – Special Provisions under Clause 1.7.2 - Mobilization, Demobilization and Temporary Communication Factitive.

1.8 BASIS OF PAYMENT

.1 Payment at the Contract price for the tender item "Field Office for Contract Administrator" shall be full compensation of all labor, equipment and materials required to supply and maintain a field office.

.1 Service and connection charges for utilities and services.

.2 Heating and ventilation costs.

.3 Long distance telephone costs directly associated with the Contract.

.4 The supply of bottled water.

.5 All land and rental costs for the field office.

.6 Supply of steps or stairs so as to provide proper access to field office.

.7 The provision of parking spaces adjacent to field office, with at least a gravel surface.

.8 Winter maintenance (snow removal, sanding).

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 Not Used

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Barriers

.2 Environmental Controls

.3 Traffic Controls

.4 Fire Routes

1.2 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute work expeditiously.

.2 Remove from site all such Work after use.

1.3 HOARDING

.1 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel “T” bar fence posts spaced at 2.4 m oc. Provide one lockable truck gate. Maintain fence in good repair.

.2 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

1.4 GUARD RAIL AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations.

.2 Provide as required by governing authorities.

1.5 ACCESS TO SITE

.1 Provide and maintain access to Work.

1.6 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect the public.

1.7 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.8 PROTECTION FOR OFF SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

Part 2 Products

Not used

Part 3 Execution

Not used

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Reference standards.

.2 Product quality, availability, storage, handling, protection, transportation.

.3 Manufacturer's instructions.

.4 Workmanship, coordination and fastenings.

.5 Existing facilities.

1.2 REFERENCE STANDARDS

.1 Within the text of the specifications, reference may be made to the following standards:

ACI - American Concrete Institute

AISC - American Institute of Steel Construction

ANSI - American National Standards Institute

ASTM - American Society of Testing and Materials

CEC - Canadian Electrical Code (published by CSA)

CEMA - Canadian Electrical Manufacturer's Association

CGSB - Canadian General Standards Board

CISC - Canadian Institute of Steel Construction

CLA - Canadian Lumberman's Association

CPCA - Canadian Painting Contractors' Association, or alternatively the Canadian Portland Cement Association

CPCI - Canadian Prestressed Concrete Institute

CRCA - Canadian Roofing Construction Association

CSA - Canadian Standards Association

CSSBI - Canadian Sheet Steel Building Institute

FM - Factory Mutual Engineering Corporation

IEEE - Institute of Electrical and Electronic Engineers

IPCEA - Insulated Power Cable Engineers Association

NAAMM - National Association of Architectural Metal Manufacturers

NBC - National Building Code

NEMA - National Electrical Manufacturers' Association

NFPA - National Fire Protection Association

TTMAC - Terrazzo, Tile and Marble Association of Canada

ULC - Underwriters' Laboratories of Canada

.2 Conform to these standards, in whole or in part as specifically requested in the specifications.

.3 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.

.4 The cost for such testing will be borne by the Owner in the event of conformance with contract documents or by the Contractor in the event of non-conformance.

.5 Conform to latest date of issue of referenced standards in effect on date of submission of bids, except where a specific date or issue is specifically noted.

1.3 QUALITY

.1 Products, materials, equipment and articles (referred to as products throughout the specifications) incorporated in the work shall be new, not damaged or defective, and of the best quality (compatible with specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

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

.3 Should any dispute arise at to the quality or fitness of products, the decision rests strictly with the Engineer based upon the requirements of the contract documents.

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

.5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.4 AVAILABILITY

.1 Immediately upon signing contract, review product delivery requirements and anticipate foreseeable supply delays for any items. It 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 the 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 the right to substitute more readily available products of similar character, at no increase in contract price.

1.5 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in a 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 the 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 a 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 the satisfaction of the Engineer.

1.6 TRANSPORTATION

.1 Pay costs of transportation of products required in the performance of work.

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

1.7 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 the Engineer in writing, of conflicts between the specifications and manufacturer's instructions, so that the Engineer may establish the 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 reinstallation at no increase in contract price.

1.8 WORKMANSHIP

.1 Workmanship shall be the best quality, executed by workers experienced and skilled in the 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 any unfit person or anyone unskilled in their required duties. The Engineer reserves the right to require the dismissal from the site, 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 the Engineer, whose decision is final.

1.9 COORDINATION

.1 Insure cooperation of workers in laying out work. Maintain efficient and continuous supervision.

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

1.10 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 a contradictory situation. Install as directed by Engineer.

1.11 REMEDIAL WORK

.1 Perform remedial work required to repair or replace the parts or portions of the 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.

1.12 LOCATION OF FIXTURES

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

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

1.13 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 noncorrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected specification section.

.4 Space anchors within their 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.

1.14 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 the Engineer, at no increase in contract price.

.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.

1.15 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, and/or building occupants.

.2 Protect, relocate or maintain existing active services. When 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 PAYMENT

.1 All work under this section shall be included in the contract and shall not result in additional payments by the Owner.

1.2 QUALITY ASSURANCE

.1 Testing organization: current member in good standing of Associated Air Balance Council (AABC - National Standards for Field Measurements and Instrumentation, Total Systems Balance, Air Distribution - Hydronics Systems) certified to perform specified services.

.2 Comply with applicable procedures and standards of the certification sponsoring association.

.3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.3 SUBMITTALS

.1 Prior to start of work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.

.2 Submit documentation to confirm organization compliance with quality assurance provision.

.3 Submit three (3) preliminary specimen copies of each of the report forms proposed for use.

.4 Seven (7) days prior to Substantial Performance, submit three (3) copies of final reports on applicable forms.

.5 Submit reports of testing, adjusting, and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

1.4 PROCEDURES GENERAL

.1 Comply with procedural standards of certifying association under whose standard services will be performed.

.2 Notify Engineer three (3) days prior to beginning of operations.

.3 Accurately record data for each step.

.4 Report to Engineer any deficiencies or defects noted during performance of services.

1.5 FINAL REPORTS

.1 Organization having managerial responsibility shall make reports.

.2 Each form shall bear signature of recorder, and that of supervisor of reporting organization.

.3 Identify each instrument used, and latest date of calibration of each.

1.6 CONTRACTOR RESPONSIBILITIES

.1 Prepare each system for testing and balancing.

.2 Cooperate with testing organization, provide access to equipment and systems.

.3 Provide personnel, operate systems at designation times, and under conditions required for proper testing, adjusting, and balancing.

.4 Notify testing organization seven (7) days prior to time project will be ready for testing, adjusting, and balancing.

1.7 PREPARATION

.1 Provide instruments required for test, adjust, and balance operations.

.2 Make instruments available to Engineer to facilitate spot checks during testing.

.3 Retain possession of instruments and remove at completion of services.

.4 Verify systems installation is complete and in continuous operation.

.5 Verify lighting is turned on when lighting is included in cooling load.

.6 Verify equipment such as computers, laboratory and electronic equipment are in full operation.

1.8 EXECUTION

.1 Test equipment, balance distribution systems, and adjust devices for HVAC systems.

.2 Test hydronic systems, adjust and record liquid flow at each piece of equipment.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel one week prior to date of Final Inspection.

.2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.2 QUALITY CONTROL

.1 When specified in individual sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.3 SUBMITTALS

.1 Submit schedule of time and date for demonstration of each item of equipment and each system two (2) weeks prior to designated dates, for Owner's approval.

.2 Submit reports within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily.

.3 Give time and date of each demonstration, with a list of persons present.

1.4 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into operation.

.2 Testing, adjusting, and balancing have been performed and equipment and systems are fully operational.

.3 Provide copies of completed Operation and Maintenance Manuals for use in demonstrations and instructions.

1.5 PREPARATION

.1 Verify that conditions for demonstration and instructions comply with requirements.

.2 Verify that designated personnel are present.

.3 Review contents of manual in detail to explain all aspects of operation and maintenance.

.4 Prepare and insert additional data in Operation and Maintenance Manuals when the need for additional data becomes apparent during instructions.

1.6 DEMONSTRATION OF INSTRUCTIONS

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled agreed upon times, at the designated location.

.2 Instruct personnel in all phases of operation and maintenance using Operation and Maintenance Manuals as the basis of instruction.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 FINAL CLEANOUT

.1 Prior to application for Certificate of Substantial Completion, remove surplus products, tools, construction machinery and equipment not required for the performance of the remaining Work.

.2 Remove waste products and debris and leave the Work clean and suitable for occupancy by Owner.

.3 When Work is completed, remove surplus products, tools, construction machinery, equipment, waste products and debris.

.4 Leave the Work areas neat and access vaults, with no stains, spots, marks or dirt, before the Interim Completion process commences.

1.2 DOCUMENTS

.1 Collect reviewed submittals and assemble documents executed by Subcontractors, Suppliers and Manufacturers.

.2 Submit material at least two (2) weeks prior to Application for Substantial Completion.

.3 Provide warranties and bonds, fully executed and notarized.

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

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

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

1.3 REMOVAL OF TEMPORARY FACILITIES

.1 Prior to application for a Certificate of Substantial Completion, remove all temporary offices and furniture, hoardings, fencing, and all other items used to aid the performance of the Work. Make good surfaces.

1.4 PROJECT COMMISSIONING

.1 Expedite and complete deficiencies and defects identified by the Engineer.

.2 Review record “as-built” drawings, spare parts, materials for completeness.

.3 Review cash and contingency allowances in relation to Contract Price, change orders, retainage, holdbacks and other Contract Price adjustments, if required.

.4 Submit required documentation, such as statutory declarations, Workers' Compensation Certificates, warranties, certificates of approval or acceptance from regulating bodies.

.5 Assist the Engineer during "end-of-work" testing, and break-in and start-up demonstrations.

.6 Review inspection and testing reports to verify conformance to the intent of the documents and that changes, repairs, or replacements have been completed.

.7 When partial occupancy of uncompleted project is required by the Owner, coordinate Owner's uses, requirements and access with Contractor's requirements to complete the Project.

.8 Provide ongoing review, maintenance and repair problems during the warranty periods.

1.5 INSPECTION/TAKEOVER PROCEDURES

.1 Prior to application for a Certificate of Substantial Completion, carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete and/or corrected and the facilities are clean and in condition for use by the Owner. Notify the Engineer in writing of satisfactory completion of the Work and request a Certificate of Substantial Completion.

.2 During the Substantial Completion Inspection, a list of deficiencies and defects will be tabulated. Correct same.

.3 When the Engineer considers deficiencies and defects have been corrected and it appears all requirements of the Contract have been performed, make application for final payment.

.4 Only one Substantial Completion Inspection is allowed. If a second inspection, including time, travel, lodgings, meals, etc. for the Engineer and the Owner.

1.6 SUBSTANTIAL AND FINAL COMPLETION

.1 Perform the following items prior to Substantial Completion.

.1 Mail warranty forms to manufacturer. Provide a copy of original warranty for equipment which has warranty period longer than one (1) year.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.3 Copy will be returned after final inspection with Engineer's comments.

.4 Revise content of documents as required prior to final submittal.

.5 Two weeks prior to Substantial Performance of the Work, submit to the Engineer, four final copies of operating and maintenance manuals in English.

.6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.7 Furnish evidence, if requested, for type, source and quality of products provided.

.8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.9 Pay costs of transportation.

1.2 FORMAT

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, Heavy-duty Piano-style hinges.

.3 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in dwg format on CD.

1.3 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project; Date of submission; names.

.1 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.

.2 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

1.4 AS-BUILTS AND SAMPLES

.1 Maintain, in addition to requirements in General Conditions, at site for Engineer, one record copy of:

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Change Orders and other modifications to Contract.

.5 Reviewed shop drawings, product data, and samples. Field test records.

.6 Inspection certificates.

.7 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Engineer.

1.5 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Engineer.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

.5 Specifications: mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain are manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.6 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.3 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.4 Provide servicing and lubrication schedule, and list of lubricants required.

.5 Include manufacturer's printed operation and maintenance instructions.

.6 Include sequence of operation by controls manufacturer.

.7 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.8 Provide installed control diagrams by controls manufacturer.

.9 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.

.10 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.11 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.12 Include test and balancing reports.

.13 Additional requirements: as specified in individual specification sections.

1.7 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-Protection and Weather-Exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.8 MAINTENANCE MATERIALS

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

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

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.9 STORAGE, HANDLING AND PROTECTION

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

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

.4 Store paints and freezable materials in a heated and ventilated room.

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

1.10 WARRANTIES AND BONDS

.1 Develop warranty management plan to contain information relevant to Warranties.

.2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Engineer approval.

.3 Warranty management plan to include required actions and documents to assure that Owner receives warranties to which it is entitled.

.4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.5 Submit, warranty information made available during construction phase, to Engineer for approval prior to each monthly pay estimate.

.6 Assemble approved information in binder and submit upon acceptance of work. Organize binder as follows:

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

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

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

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

.5 Co-execute submittals when required.

.6 Retain warranties and bonds until time specified for submittal.

.7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.8 Conduct joint 9 month warranty inspection, measured from time of acceptance, by Engineer.

.9 Include information contained in warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.

.2 Listing and status of delivery of Certificates of Warranty for extended warranty items.

.3 Provide list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of manufacturers or suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.4 Procedure and status of tagging of equipment covered by extended warranties.

.5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

.10 Respond in a timely manner to oral or written notification of required construction warranty repair work.

.11 Written verification will follow oral instructions. Failure to respond will be cause for the Engineer to proceed with action against Contractor.

1.11 PRE-WARRANTY CONFERENCE

.1 Meet with Engineer, to develop understanding of requirements of this section. Schedule meeting prior to contract completion, and at time designated by Engineer.

.2 Engineer will establish communication procedures for:

.1 Notification of construction warranty defects.

.2 Determine priorities for type of defect.

.3 Determine reasonable time for response.

.3 Provide name, telephone number and address of licensed and bonded company that is authorized to initiate and pursue construction warranty work action.

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.12 WARRANTY TAGS

.1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Engineer.

.2 Attach tags with copper wire and spray with waterproof silicone coating.

.3 Leave date of acceptance until project is accepted for occupancy.

.4 Indicate following information on tag:

.1 Type of product/material.
.2 Model number.
.3 Serial number.
.4 Contract number.
.5 Warranty period.
.6 Inspector's signature.
.7 Construction Contractor.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 20 05 00 – Mechanical General Requirements.

.2 Section 20 05 93 – Testing, Adjusting and Balancing (TAB) of Mechanical Systems.

.3 Section 22 10 10 – Pumps – Plumbing.

.4 Section 22 30 05 – Domestic Water Heaters.

.5 Section 22 42 00 – Plumbing Piping, Valves and Fittings.

.6 Section 22 42 01 – Plumbing Specialities and Accessories.

.7 Section 23 21 23 – Pumps – Hydronic Systems.

.8 Section 23 21 30 – Hydronic Heaters.

.9 Section 23 34 00 – Commercial Fans.

.10 Section 25 00 00 – Controls and Instrumentation.

.11 Section 26 12 16.01 – Dry-Type Transformers up to 600 V Primary.

.12 Section 31 20 50 – Thermosyphons.

1.2 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

.2 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.
.8 TAB - Testing, Adjusting and Balancing.

1.3 GENERAL

.1 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. 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 BMM.
- .3 Effectively train O&M staff.

.2 Contractor assists in 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 interactive 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 Design Criteria: as per client's requirements or determined by designer. To meet project’s functional and operational requirements.

.4 AFD managed projects the term Engineer in Cx specifications to be interpreted as AFD Service Provider.

1.4 COMMISSIONING OVERVIEW

.1 Cx to be a line item of Contractor's cost breakdown.

.2 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.3 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

.4 The Engineer will issue Interim Acceptance Certificate when:

- .1 Completed Cx documentation has been received, reviewed for suitability and approved by both the Owner and the Engineer.
- .2 Equipment, components and systems have been commissioned.
- .3 O&M training has been completed.

1.5 SUBMITTALS

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

.1 Submit proposed Cx procedures to the Engineer where not specified and obtain written approval at least four (4) weeks prior to start of Cx.

.2 Provide additional documentation relating to Cx process required by the Engineer.

1.6 STARTING AND TESTING

.1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.7 WITNESSING OF STARTING AND TESTING

.1 Provide fourteen (14) days notice prior to commencement.

.2 GN Representative and the Engineer to witness start-up and testing.

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

1.8 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and testing in following distinct phases:

.1 Included in delivery and installation:

.1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.

.2 Visual inspection of quality of installation.

.2 Start-up: follow accepted start-up procedures.

.3 Operational testing: document equipment performance.

.4 System PV: include repetition of tests after correcting deficiencies.

.5 Post-substantial performance verification: to include fine-tuning.

.3 Correct deficiencies and obtain approval from the Engineer after distinct phases have been completed and before commencing next phase.

.4 Document required tests on approved PV forms.

1.9 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to the Engineer for approval before commencement of commissioning.

.2 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports.

.5 Step-by-step description of complete start-up procedures, to permit Public Works Departmental Representative to repeat start-up at any time.

1.10 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit to the Engineer for approval before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.11 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.

1.12 START OF COMMISSIONING

.1 Notify the Engineer at least 21 days prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.13 WITNESSING COMMISSIONING

.1 Both Government of Nunavut and the Engineer to witness activities and verify results.

1.14 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Engineer.

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

1.15 COMPLETION OF COMMISSIONING

.1 Upon completion of Cx leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by the Engineer.

1.16 ACTIVITIES UPON COMPLETION OF COMMISSIONING

.1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.17 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

.1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.18 OCCUPANCY

.1 Cooperate fully with the Government of Nunavut during stages of acceptance and occupancy of facility.

Part 2 Products

Not Used

Part 3 Execution

Not Used

END OF SECTION

Part 1 General

The following specification relates to the Type 2 / Moderate Risk removal of potential non-friable asbestos containing materials if the materials are to be removed with power tools equipped with dust collection devices attached to a HEPA vacuum. This specification is considered provisional as an asbestos containing material survey has not been performed on the building, however asbestos-containing materials may be encountered during the demolition. Suspect asbestos containing materials that may be present at the site (based on visual inspection and age of the building) include:

.1 Caulking and sealants (interior and exterior).

.2 Gasket materials

As the building is being demolished, there is the potential that asbestos-containing materials may be identified within wall and ceiling cavities.

1.2 SUMMARY

.1 Comply with requirements of this Section when performing following Work:

.1 Removing non-friable asbestos containing materials by breaking, cutting, drilling, abrading, grounding, sanding or vibrating if:

.1 The material is not wetted to control the spread of dust or fibres, and

.2 The work is done only by means of non-powered hand-held tools.

.2 Removing non-friable asbestos containing materials by breaking, cutting, drilling, abrading, grounding, sanding or vibrating if the work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.

1.3 SECTION INCLUDES

.1 Requirements and procedures for asbestos abatement of asbestos containing materials of the type described within.

1.4 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.205-[94], Sealer for Application of Asbestos Fibre Releasing Materials.

.2 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Government of the Northwest Territories (NWT)

.1 General Guidelines, Asbestos Removal and Disposal (2010).

.4 Government of Nunavut (NU)

.1 Nunavut Environmental Guideline for the General Management of Hazardous Waste (2010) (NUHW).

.2 Nunavut Environmental Guideline for Waste Asbestos (2011) (NUWA).

.3 Asbestos Safety Regulations (2007)

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.7 Trow Associates Inc.,

.1 Designated Substances Survey, Bunker, North of Siktuuq Court, Iqaluit, NU, Reference # OTEN-00020388-A, March, 2010

.8 Underwriters' Laboratories of Canada (ULC)

1.5 DEFINITIONS

.1 Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.

.2 Asbestos Containing Materials (ACMs): materials that contain 1 per cent or more (territorial regulated) asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.3 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.

.4 Authorized Visitors: Engineer[s], or designated representative[s], and representative[s] of regulatory agencies.

.5 Competent worker: in relation to specific work, means a worker who:

.1 Is qualified because of knowledge, training and experience to perform the work.

.2 Is familiar with the territorial laws and with the provisions of the regulations that apply to the work.

.3 Has knowledge of all potential or actual danger to health or safety in the work.

.6 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another. Typically constructed as follows:

.1 Place two overlapping polyethylene sheets over existing or temporarily framed doorway, securing each along top of doorway, securing vertical edge of one sheet along one vertical side of doorway, and secure other sheet along opposite vertical side of doorway.

.2 Reinforce free edges of polyethylene with duct tape and add weight to bottom edge to ensure proper closing.

.3 Overlap each polyethylene sheet at openings 1.5 m on each side.

.7 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.

.8 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.9 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.10 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.6 SUBMITTALS

.1 Submit proof satisfactory to designated representative that suitable arrangements have been made to dispose of asbestos containing waste in accordance with requirements of authority having jurisdiction.

.2 Submit Territorial and/or local requirements for Notice of Project Form.

.3 Submit proof of Contractor's Asbestos Liability Insurance.

.4 Submit to designated representative necessary permits for transportation and disposal of asbestos containing waste and proof that asbestos containing waste has been received and properly disposed.

.5 Submit proof satisfactory to designated representative that all asbestos workers have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.

.6 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by designated representative. Minimum of one supervisor for every ten workers.

.7 Submit Worker's Compensation Board status and transcription of insurance.

.8 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:

.1 Encapsulants;

.2 Amended water;

.3 Slow drying sealer.

.9 Submit proof satisfactory to designated representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Territorial and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at the time work is performed.

.2 Health and Safety:

.1 Safety Requirements: worker and visitor protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:

.1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Territory Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between

the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

.2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and it to be repaired or replaced if torn.

.2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.3 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

.4 Ensure workers wash hands and face when leaving Asbestos Work Area.

.5 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

.6 Visitor Protection:

.1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.

.2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.

.3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal materials for recycling and/or reuse.

.3 Separate for reuse and recycling and place in designated containers steel/metal/plastic waste.

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Local regulations.

.6 Disposal of asbestos waste generated by removal activities must comply with Federal, Territorial and Local regulations. Dispose of asbestos waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.

.7 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.9 EXISTING CONDITIONS

.1 Reports and information pertaining to ACMS to be handled, removed, or otherwise disturbed and disposed of during this Project are attached to this specification.

.2 Notify designated representative of friable material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by designated representative.

1.10 SCHEDULING

.1 Hours of Work: perform work involving asbestos abatement located at during normal working hours.

1.11 OWNER'S INSTRUCTIONS

.1 Before beginning Work, provide designated representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, in use of glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to respirators includes, at minimum:

.1 Fitting of equipment.

.2 Inspection and maintenance of equipment.

.3 Disinfecting of equipment.

.4 Limitations of equipment.

.3 Instruction and training must be provided by competent, qualified person.

Part 2 Products

2.1 MATERIALS

.1 Drop and Enclosure Sheets:

.1 Polyethylene: 0.15 mm thick.

.2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos containing material.

.3 Waste Containers: contain waste in two separate containers.

.1 Inner container: 0.15 mm thick sealable polyethylene bag.

.2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.

.3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.

.4 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.

.5 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.1 Sealer: flame spread and smoke developed rating less than 50.

Part 3 Execution

3.1 SUPERVISION

.1 Minimum of one Supervisor for every ten workers is required.

.2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

.1 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)'.

.2 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.

.1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.

.2 Do not use compressed air to clean up or remove dust from any surface.

.3 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.

Interior Work

.1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained.

.2 Erect enclosure of polyethylene sheeting at entrance and windows, shut off mechanical ventilation system serving work area and seal ventilation ducts to and from building, if present.

.3 A curtained doorway should be applied at the entrance of the enclosure to minimize the spread of dust.

Exterior Work

.1 If asbestos containing material requires Type 2 removal methods based on the contractor's procedure, place polyethylene sheeting on the ground cover in work area and erect a temporary polyethylene enclosure around the work area to prevent wind and/or weather from causing the uncontrolled spread or debris.

.2 Temporary enclosure can consist of a three-wall portable enclosure constructed of wood (or other suitable material) framed structure with polyethylene sheeting and/or thin meshed construction netting that can mounted against the building.

.3 A curtained doorway should be applied at the entrance of the enclosure to minimize the spread of dust.

.4 Remove loose material by HEPA vacuum; thoroughly wet friable material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.

.1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.

.2 Perform Work in a manner to reduce dust creation to lowest levels practicable.

.5 Work is subject to visual inspection. Contamination of surrounding areas indicated by visual inspection will require complete enclosure and clean-up of affected areas.

.6 Cleanup:

.1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.

.2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.

.3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.

.4 Seal and remove double bagged waste from site. Dispose of in accordance with requirements of Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.

.5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

END OF SECTION

Part 1 General

The following specification relates to the Type 1 / Low Risk removal of potential non-friable asbestos containing materials using non-powered hand tools. This specification is considered provisional as an asbestos containing material survey has not been performed on the building, however asbestos-containing materials may be encountered during the demolition. If the contractor deems that mechanical equipment is required to remove the materials, proceed to Section 02 82 00.02. Suspect asbestos containing materials that may be present at the site (based on visual inspection and age of the building) include:

.1 Caulking and sealants (interior and exterior).

.2 Gasket materials

As the building is being demolished, there is the potential that asbestos-containing materials may be identified within wall and ceiling cavities.

1.2 SUMMARY

.1 Comply with requirements of this Section when performing following work:

.1 Removing non-friable asbestos-containing materials, if the material is installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.

.2 Break, cut, grind, sand, drill, scrape, vibrate or abrade non-friable asbestos containing materials using non-powered hand-held tools, and the material is wetted to control the spread of dust or fibres.

1.3 SECTION INCLUDES

.1 Requirements and procedures for asbestos abatement of non-friable asbestos-containing materials.

1.4 REFERENCES

.1 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.2 Government of the Northwest Territories (NWT)

.1 General Guidelines, Asbestos Removal and Disposal (2010).

.3 Government of Nunavut (NU)

.1 Nunavut Environmental Guideline for the General Management of Hazardous Waste (2010) (NUHW).

.2 Nunavut Environmental Guideline for Waste Asbestos (2011) (NUWA).

.3 Asbestos Safety Regulations (2007)

.4 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.5 DEFINITIONS

.1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.2 Amended Water: water with nonionic surfactant wetting agent added to reduce water tension to allow thorough wetting of fibres.

.3 Asbestos-Containing Materials (ACMs): materials that contain 1 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.4 Asbestos Work Area: area where work takes place which will, or may, disturb ACMs.

.5 Authorized Visitors: Engineer[s], Consultant[s] or designated representative[s], and representative[s] of regulatory agencies.

.6 Competent worker: in relation to specific work, means a worker who:

.1 Is qualified because of knowledge, training and experience to perform the work.

.2 Is familiar with the territorial laws and with the provisions of the regulations that apply to the work.

.3 Has knowledge of all potential or actual danger to health or safety in the work.

.7 Friable material: means material that:

.1 When dry, can be crumbled, pulverized or powdered by hand pressure, or

.2 is crumbled, pulverized or powdered.

.8 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.9 Occupied Area: any area of the building or work site that is outside Asbestos Work Area.

.10 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.11 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for work.

1.6 SUBMITTALS

.1 Submit proof satisfactory to Designated Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authorities having jurisdiction.

.2 Submit Territorial and/or local requirements for Notice of Project Form.

.3 Submit proof of Contractor's Asbestos Liability Insurance.

.4 Submit to Designated Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.

.5 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.

.6 Submit proof satisfactory to Designated Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Territorial, and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications, more stringent requirement applies. Comply with regulations in effect at time Work is performed.

.2 Health and Safety:

.1 Safety Requirements: worker protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:

.1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Territorial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

.2 Disposable-type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.

.2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.3 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before

removal from the work area, and removed from the work area frequently and at regular intervals.

.4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.

.5 Ensure workers wash hands and face when leaving Asbestos Work Area.

.6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Place materials defined as hazardous or toxic in designated containers.

.2 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, NUHW, NUWA, and local regulations.

.3 Disposal of asbestos waste generated by removal activities must comply with Federal, Territorial, and local regulations. Dispose of asbestos waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.

.4 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.9 EXISTING CONDITIONS

.1 Reports any information pertaining to ACMs to be handled, removed, or otherwise disturbed and disposed of during this project are included into this specification.

.2 Notify Designated Representative of friable material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Designated Representative.

1.10 SCHEDULING

.1 Hours of Work: perform work involving asbestos abatement during normal working hours.

1.11 OWNER'S INSTRUCTIONS

.1 Before beginning Work, provide Designated Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to respirators includes, following minimum requirements:

.1 Fitting of equipment.

.2 Inspection and maintenance of equipment.

.3 Disinfecting of equipment.

.4 Limitations of equipment.

.3 Instruction and training must be provided by a competent, qualified person.

Part 2 Products

2.1 MATERIALS

.1 Drop Sheets:

- .1 Polyethylene: 0.15 mm thick.
- .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in a concentration to provide thorough wetting of asbestos-containing material.

.3 Waste Containers: contain waste in two separate containers.

- .1 Inner container: 0.15 mm thick sealable polyethylene waste bag.
- .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
- .3 Labelling requirements: affix pre-printed cautionary asbestos warning in both official languages that is visible when ready for removal to disposal site.

.4 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.5 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using amended water.

Part 3 Execution

3.1 PROCEDURES

.1 Before beginning Work, isolate Asbestos Work Area using, minimum, pre-printed cautionary asbestos warning signs in all official languages that are visible at access routes to Asbestos Work Area.

- .1 Remove visible dust from surfaces in the work area where dust is likely to be disturbed during course of work.
- .2 Use HEPA vacuum or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate.
- .3 Do not use compressed air to clean up or remove dust from any surface.

.2 Place polyethylene sheet on the base of the work area so that asbestos-containing debris from removal can be easily cleaned with vacuum and/or wet mop. Drop sheets are not to be reused.

- .1 If wind and or weather prevents the control of non-friable asbestos debris within the work area, then construction safety netting and/or polyethylene sheeting shall be erected around the work area.

.3 Wet materials containing asbestos to be cut, ground and/or scraped, or otherwise disturbed unless wetting creates hazard or causes damage.

- .1 Use garden reservoir type low - velocity fine - mist sprayer.
- .2 Perform Work to reduce dust creation to lowest levels practicable.
- .3 Work will be subject to visual inspection.

.4 Contamination of surrounding areas indicated by visual inspection will require complete enclosure and clean-up of affected areas.

.4 Frequently and at regular intervals during Work and immediately on completion of work:

.1 Dust and waste to be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in a waste container, and

.2 Drop sheets to be wetted and placed in a waste container as soon as practicable.

.5 Cleanup:

.1 Place dust and asbestos containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste; wet and fold these items to contain dust, and then place in plastic bags.

.2 Clean exterior of each waste-filled bag using damp cloths or HEPA vacuum and place in second clean waste bag immediately prior to removal from Asbestos Work Area.

.3 Seal waste bags and remove from site. Dispose of in accordance with requirements of Territorial and Federal Authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that the appropriate guidelines and regulations for asbestos disposal are followed.

.4 Perform final thorough clean-up of Work areas and adjacent areas affected by Work using HEPA vacuum.

END OF SECTION

Part 1 General

The following specification related to the removal of potential Polychlorinated Biphenyls (PCBs). This specification is considered provisional as PCB sampling has not been performed, however PCB containing materials/equipment may be encountered during the demolition. Suspect PCB containing materials/equipment that may be present at the site (based on visual inspection and age of the building) include:

.1 Caulking and sealants (interior and exterior).

.2 Light ballasts/transformers.

1.2 SECTION INCLUDES

.1 Procedures and materials required for the safe handling, management and disposal of potential polychlorinated biphenyl (PCB) containing caulking and/or equipment on or within the Char Lake Pump house.

1.3 REFERENCES

.1 American Board of Industrial Hygiene (ABIH)

.2 Canadian Council of Ministers of the Environment (CCME)

.1 PN1205-03, PCB Transformer Decontamination: Standards and Protocols.

.3 Department of Justice Canada (Jus)/CEPA SOR/92-507-[SOR/2000-102], Storage of PCB Material Regulations

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.4 Environment Canada

.1 Federal Regulation SOR/2008-273, PCBs Regulations

.2 Manual for Spills of Hazardous Materials-1985.

.5 Government of Nunavut (NU)

.1 Nunavut Environmental Guideline for the General Management of Hazardous Waste (2010) (NUHW).

.6 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.7 Ontario Ministry of the Environment- Environmental Protection Act R.R.O 1990

.1 Waste Management - PCBs, R.R.O. Regulation 362/90.

.2 Regulation 347, General Waste Management, as Amended.

1.4 SUBMITTALS

.1 Prior to starting work, Contractor performing work of this section to provide:

.1 Workplace Safety and Insurance Board Clearance Certificate.

.2 Insurance certificates- Including Environmental Impairment Liability- with a hazardous materials endorsement

.3 Company Health and Safety Policy.

.4 WHMIS Training Certificates for Personnel.

.5 Material Safety Data Sheets for chemicals or material to be used.

1.5 QUALITY ASSURANCE

.1 Instruct personnel on dangers of PCB exposure, respirator use, decontamination and applicable Federal, Territorial, and Municipal Regulations.

.2 Complete work so that at no time do PCB's contaminate building, site and environment.

1.6 SUPERVISION

.1 Provide onsite, a supervisor, with authority to oversee health and safety, remediation methods, scheduling, labour and equipment requirements.

.2 One supervisor for every 10 workers is required.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Place materials defined as hazardous or toxic in designated containers.

.2 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.3 Disposal of PCB waste generated by removal activities must comply with Federal, Territorial, and Municipal regulations.

.1 Dispose of PCB waste in rigid leak proof containers.

.2 Containers must be labelled with appropriate warning labels.

Part 2 Products

2.1 MATERIALS

.1 Drop Sheets:

.1 Polyethylene: 0.15 mm thick.

.2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions.

2.2 STORAGE GENERAL

.1 Storage of PCB materials in accordance with CEPA SOR/92-507.

2.3 STORAGE ENCLOSURE

.1 Isolate PCB control area by physical boundaries to prevent unauthorized entry of personnel.

.2 Food, drink and smoking materials are not permitted in areas where PCBs are handled or PCB items are stored.

.3 Room, building or structure with lockable entrance.

.4 Temporary storage facility to be a fully enclosed, secure and labelled with appropriate warning signs.

.5 Smoking is not permitted within 15 m of PCB control area.

2.4 STORAGE CONTAINERS

.1 PCB solid, liquid storage.

- .1 Drums and containers:
  - .1 Designed with sufficient durability and strength to prevent PCB from being released into environment, affected by weather, or contaminated by external sources.
  - .2 Steel, other material approved Consultant.
- .2 Drums:
  - .1 Capacity no greater than 205 litres.
  - .2 Steel of minimum 1.2 mm for solids1.52 mm for liquids.
  - .3 Ensure removable steel lid securely attached and complete with PCB-resistant gasket.
  - .4 Paint or treat to prevent rusting.
- .3 Drum Liners:
  - .1 6 mil clear polyethylene bag.

2.5 WARNING SIGNS AND LABELS

.1 Label container of waste generated by the decontamination of chlorobiphenyls with black and white, "ATTENTION PCB" label.

.2 Label doors to storage sites, fencing and other security barriers enclosing storage sites with black and white, "ATTENTION PCB" label.

.3 Maintain signs and labels in clear and legible condition.

Part 3 Execution

3.1 GENERAL

.1 Store PCB waste materials to CEPA SOR/92-507.

.2 Select PCB removal procedure to minimize contamination of work areas with PCB or other PCB-contaminated debris/waste. Handle PCBs such that no skin contact occurs.

.3 As feasible, do not carry out PCB handling operations in confined spaces. Confined space means space having limited means of egress and inadequate cross ventilation.

.4 Ensure that work operations or processes involving PCB or PCB-contaminated materials are conducted in accordance with Federal, Territorial, and Municipal Regulations and applicable requirements of this Section, including but not limited to:

.1 Obtaining advance approval of PCB storage sites.

.2 Notify Consultant prior to beginning operations.

3.2 ACCESS TO SITE

.1 Keep entrance to site locked.

.2 Permit only authorized personnel to enter site.

3.3 ACCESS TO STORED MATERIAL

.1 Store materials and equipment to permit easy access for inspection.

3.4 STORAGE PRACTICES

.1 Stack containers only if designed for stacking.

.2 Store material to prevent it catching fire.

.3 Store material to prevent it being released.

.4 Store PCB material together, and away from other stored materials.

3.5 PERSONAL PROTECTION

.1 Use impervious clothing (hooded chemical resistant poly-coated disposable coveralls), gloves, face shields and other appropriate protective clothing necessary to prevent skin contact. Do not use natural rubber, neoprene, or polyvinyl chloride (PVC).

.2 Place contaminated clothing in closed containers for storage. Dispose of contaminated clothing in same manner as PCBs.

3.6 DECONTAMINATION

.1 Before beginning Work, isolate Work Area using, caution tape and appropriate signage.

.1 Remove visible dust from surfaces in the work area where dust is likely to be disturbed during course of work.

.2 Place polyethylene sheet on the base of the work area so that PCB-containing debris from removal can be easily cleaned with vacuum and/or wet mop. Drop sheets are not to be reused.

.1 If wind and or weather prevents the control of PCB debris within the work area, then construction safety netting and/or polyethylene sheeting shall be erected around the work area.

.3 Remove PCB containing caulking from attached structure and place in appropriate drums for disposal.

.4 Remove suspect PCB containing ballasts/transformer from light fixtures prior to demolition to identify if the ballast is PCB containing. If the ballast is suspect to contain PCB containing oil it shall be placed in drums for disposal.

3.7 SANITATION

.1 Prohibit eating and smoking in work area.

.2 Wash hands and face thoroughly with soap or mild detergent and water after handling PCB waste.

3.8 FIELD QUALITY CONTROL

.1 Consultant to verify successful decontamination by visual inspection.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 03 20 00 – Concrete Reinforcing.

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

.3 Section 07 21 20 – Rigid Insulation.

.4 Section 07 92 10 – Joint Sealants.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM International)

.1 ASTM F1667-17, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

.2 Canadian Standards Association (CSA)

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA O86-14, Engineering Design in Wood.

.3 CSA O121-17, Douglas Fir Plywood.

.4 CSA O141-05(R2014), Softwood Lumber.

.5 CSA O151-17 Canadian Softwood Plywood.

.6 CSA O153-13, Poplar Plywood.

.7 CAN/CSA S269.3-M92(R2013), Concrete Formwork.

.3 Council of Forest Industries of British Columbia (COFI)

.1 COFI Exterior Plywood for Concrete Formwork.

.4 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene Boards and Pipe Coverings.

1.3 SHOP DRAWINGS

.1 Submit shop drawings for formwork in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CAN/CSA-S269.3 for formwork drawings.

.3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

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

.5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Territory of Nunavut of Canada.

.6 Submit WHMIS MSDS – Material Safety Data Sheets.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Store and manage hazardous materials in accordance with manufacturer's instructions.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Divert unused form release material from landfill to an official hazardous material collections site as approved by the Engineer.

Part 2 Products

2.1 MATERIALS

.1 Formwork materials:

.1 For exposed surfaces use square-edged, smooth surfaced panels true in plane, free of holes, surface markings and defects.

.2 For unexposed surfaces use square-edged tongue and groove lumber, plywood or other material suitable to retain concrete without leakage or distortion.

.3 For concrete without special architectural features Douglas Fir plywood to CSA 086, CSA O121, and CSA O153.

.4 For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2.

.5 Lumber: to CSA O141.

.6 Nails, spikes and staples to be galvanized or phosphatized, conforming to ASTM F1667.

.7 Rigid insulation board: to Section 07 21 20 - Rigid Insulation.

.2 Form ties:

.1 For concrete not designated 'Architectural', use removable or snap-off metal type with metal form spacers, fixed or adjustable length complete with rubber washer waterstop rings and free of devices leaving holes larger than 25 mm in diameter in concrete surface and not leaving metal closer than 40 mm from surface of concrete. Wire ties are not permitted

.2 For Architectural and exposed concrete use plastic cone snap ties complete with light grey concrete plugs.

.3 Form liner: medium density overlay Douglas Fir to CSA O121 for sumps and trenches.

.4 Form release agent: colourless mineral oil, non-toxic, biodegradable, low VOC for use in potable water reservoir construction, which will not stain concrete or impair natural bonding or colour characteristics of coating/waterproofing intended for use on concrete.

.5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC for use in potable water reservoir construction, free of kerosene, which will not stain concrete or impair natural bonding or colour characteristics of coating/waterproofing intended for use on concrete.

.6 Corner or Chamfer Fillets: extruded plastic or mill finish pine, 20 mm width, maximum possible lengths, mitre ends.

.7 Sealing tape: reinforced, self-adhesive polyvinyl-chloride.

.8 Form Tie Hole Repair Mortars: to Section 03 30 00 – Cast-in-Place Concrete.

.9 Sealant: to Section 07 92 10 - Joint Sealants.

Part 3 Execution

3.1 EXAMINATION

.1 Before starting this work examine work done by others, which affects this work.

.2 Rectify all conditions, which would prejudice proper completion of this work.

.3 Commencement of work implies acceptance of existing conditions.

3.2 FABRICATION AND ERECTION

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

.2 Fabricate and erect formwork in accordance with CAN/CSA S269.3 to produce finished concrete conforming to surfaces, shapes, lines and dimensions, locations and levels indicated on the drawings within tolerances required by CAN/CSA A23.1. Ensure visible lines of the curbs, barriers, and walls follow a smooth profile both vertically and horizontally.

.3 Arrange and assemble formwork to permit removal without damage to concrete. No earth forms permitted.

.4 Set shores supporting forms for girders, beams, slabs and other horizontal members on wedges or other approved adjustable supports. Do not place shores and mud sills on frozen ground.

.5 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.6 Align form joints and make watertight to prevent leakage of cement paste and disfiguration of concrete. Keep form joints to minimum.

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

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

.9 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.10 Line forms for following surfaces:

.1 Trenches and pits.
.2 Secure lining taut to formwork to prevent folds.
.3 Pull down lining over edges of formwork panels.
.4 Ensure lining is new and not reused material.
.5 Ensure lining is dry and free of oil when concrete is poured.
.6 Application of form release agents on formwork surface is prohibited where drainage lining is used.
.7 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.

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

.12 Check and re-adjust formwork to required lines and levels during placement of concrete.

.13 If form sheathing is to be reused, remove nails and clean surfaces in contact with concrete before reusing.

3.3 TOLERANCES

.1 Construct formwork to produce concrete with dimensions, lines and levels within the following tolerances. Tolerances are not cumulative.

.1 Deviation from vertical line for piers and walls: 6 mm in 3 m, 9 mm in 6 m, and 20 mm in 12 m or more.
.2 Deviation from flat surface for deck slab, and top of walls and barriers: 3 mm in 3 m.
.3 Deviation from horizontal line: 6 mm in 3 m.
.4 Deviation from position of piers and walls: 6 mm.
.5 Deviation in cross-sectional dimensions of piers and walls or thickness of Slabs: + 6 mm / - 0 mm.

.2 If tolerances are exceeded, remove, replace or modify placed concrete as directed by the Engineer at no cost to the Owner.

3.4 EMBEDDED ITEMS

.1 Provide formed openings where required for pipes, conduits, sleeves and other work to be embedded in and passing through the concrete members.

.2 Accurately locate and set in place, items which are to be cast directly into concrete.

.3 Coordinate the work of other Sections and cooperate with trades involved in forming openings, slots, recesses, chases and setting sleeves, bolts, anchors and other inserts.

.4 Coordinate installation of concrete accessories.

.5 Set anchor bolts, sleeves and inserts accurately at the positions designated. Secure in position by means of wooden templates and ties to prevent shifting and floating during concrete placement.

.6 Do not set anchor bolts, sleeves and inserts into placed concrete.

3.5 QUALITY CONTROL

.1 Inspect and check complete formwork, falsework, shoring and bracing to ensure that the work is in accordance with formwork design and that supports, fastenings, wedges, ties and parts are secure.

.2 Inform Engineer when formwork is complete and has been cleaned to allow for inspection. Engineer's inspection shall be for verification that forms are clean and free from debris.

.3 Do not patch formwork for all exposed concrete surfaces.

.4 Allow the Engineer to inspect each section of formwork prior to reuse. Formwork may be reused if approved by the Engineer.

3.6 CLEANING

.1 Clean forms as erection proceeds to remove foreign matter. Remove cuttings, shavings and debris from within the forms. Flush completely with water to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

.2 During cold weather, remove ice and snow from within the forms. Do not use de-icing salts. Do not use water to clean out completed forms unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.

3.7 PREPARARTION

.1 Apply form release agent in accordance with the manufacturer's recommendations prior to placing reinforcing steel, anchoring devices and embedded parts.

.2 Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings, which are affected by the agent. Soak inside surfaces of untreated forms with clean water. Keep Surfaces moist prior to placing the concrete.

3.8 REMOVAL AND RESHORING

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

.1 2 days for walls and footing slabs greater than 400 mm thick.

.2 1 day for footings.

.2 Remove falsework progressively in accordance with regulatory requirements and ensure that no shock loads or imbalanced loads are imposed on the structure.

.3 Loosen forms carefully. Do not apply tools to exposed concrete surfaces.

.4 Store removed forms for exposed architectural concrete in a manner that surfaces to be in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.

.5 Removal of forms subject to approved on-going curing procedures.

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 03 10 00 – Concrete Forming and Accessories.

.2 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM A775/A775M-17, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

.2 ASTM A1064/A1064M-17, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete.

.2 Canadian Standards Association (CSA International)

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.

.2 CAN/CSA A23.3-14, Design of Concrete Structures.

.3 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.

.4 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.

.3 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC-2010, Reinforcing Steel Manual of Standard Practice.

1.3 SHOP DRAWINGS

.1 Submit shop drawings including placing of reinforcement in accordance with Section 01 33 00 - Submittal Procedures.

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

.3 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices if approved by Engineer, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers.

.4 Detail lap lengths and bar development lengths to CAN/CSA-A23.3 unless otherwise indicated. Provide Class B tension lap splices unless otherwise indicated.

.5 Detail reinforcing to ensure there are no interferences with anchor rods and other embedments.

1.4 QUALITY ASSURANCE

.1 Upon request submit Mill Test Report to Engineer with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work

.2 Upon request submit in writing to Engineer proposed source of reinforcement material to be supplied.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in a manner so as to prevent damage and contamination.

.2 Use padded bundling bands and multiple supports.

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Engineer.

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

.3 Cold-drawn annealed steel wire ties: to ASTM A82/A82M minimum 1.6 mm.

.4 Deformed steel wire for concrete reinforcement: to ASTM A82/A82M.

.5 Welded steel wire fabric: to ASTM A1064/A1064M.

.1 Provide in flat sheets only.

.6 Welded deformed steel wire fabric: to ASTM A1064/A1064M.

.1 Provide in flat sheets only.

.7 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2 adequately sized for strength and support of reinforcing steel during construction. Metal chairs shall be galvanized. Where adjacent to exposed concrete surfaces use plastic coated type.

.8 Mechanical splices: subject to acceptance by Engineer.

.9 Plain round bars: to CSA-G40.20/G40.21.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2, and RSIC Reinforcing Steel Manual of Standard Practice.

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

.3 Welding of reinforcement is not permitted.

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

.5 Fabricate within the following tolerances:

.1 Sheared Length: +/- 25 mm.

.2 Stirrups, Ties and Spirals: +/- 10 mm.

.3 Other Bends: +/- 25 mm.

.6 Locate reinforcing splices not shown on drawings at point of minimum stress.

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 commencing reinforcing work.

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

Part 3 Execution

3.1 FIELD BENDING

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

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

.3 Replace bars which develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA A23.1/A23.2.

.2 Use plain round bars as slip dowels in concrete.

.1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

.2 When paint is dry, apply thick even film of mineral lubricating grease.

.3 Ensure all loose scale, loose rust and other deleterious matter from surfaces of reinforcing is removed in a manner which is acceptable to the Engineer.

.4 Place, support and secure reinforcement against displacement. Do not deviate from required position.

.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.

3.3 CLEANING

.1 Leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 03 10 00 - Concrete Forming and Accessories.

.2 Section 03 20 00 - Concrete Reinforcing.

1.2 WORK INCLUDED

.1 All plain and reinforced cast-in-place concrete shown on the Drawings unless specifically excluded, and includes but is not limited to the following:

.1 Foundations, slabs and curbs.

.2 Repairing concrete imperfections.

.3 Installation of anchor bolts and other accessories as required to accommodate the work of other Sections.

1.3 MEASUREMENT PROCEDURES

.1 Cast-in-place concrete will not be measured but will be paid for as a fixed price item.

.2 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.

.3 Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.

.4 Supply and installation of anchor bolts, nuts and washers and bolt grouting will not be measured but considered incidental to work.

1.4 REFERENCES

.1 American Concrete Institute (ACI)

.1 ACI 306R-16, Guide to Cold Weather Concreting.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM C260/260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C494/C494M-16, Standard Specification for Chemical Admixtures for Concrete.

.4 ASTM C827/C827M-16, Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.

.5 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.6 ASTM D412--16 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers -Tension.

.7 ASTM D624-00(2012), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

.8 ASTM D1751-04(2013)e1, Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

.9 ASTM D1752-04a(2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Considerations.

.10 ASTM E1745-11, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.4 Canadian Standards Association (CSA)

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.

.2 CSA A283-06(R2016), Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.5 SAMPLES

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

.2 At least 4 weeks prior to commencing work, inform Engineer of proposed source of aggregates and provide access for sampling.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Minimum 4 weeks prior to starting concrete work submit to Engineer manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:

.1 Portland cement.

.2 Blended hydraulic cement.

.3 Supplementary cementing materials.

.4 Grout.

.5 Admixtures.

.6 Aggregates.

.7 Water.

.8 Joint filler, sealant and expansion filler.

.9 Waterstops.

.10 Adhesive grout.

.11 Curing/sealer.

.3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA A23.1.

.4 Provide certification report for fine and coarse aggregate, for alkali-aggregate reactivity tests carried out in accordance with CSAA23.2 except:

.1 Testing period shall be two years.

.2 Minimum cement content shall be 430 kg/m^3.

.3 Specimen expansion shall not exceed 0.035% during test period.

.5 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA A23.1.

.6 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 PART 3 – FIELD QUALITY CONTROL.

.7 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.

.8 Provide two copies of WHMIS MSDS in accordance with 01 33 00 – Submittal Procedures.

1.7 QUALITY ASSURANCE

.1 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for Engineer's approval for following items:

.1 Hot weather concrete procedures.

.2 Cold weather concrete procedures.

.3 Methods to maintain construction within tolerances.

.4 Placement method(s), including mass concrete placement.

.5 Curing method(s) to be utilized and testing method to confirm concrete has fully cured.

.6 Protection of finished work during curing.

.7 Method of confirmation that concrete has been cured according to specifications.

.8 Finishes.

.9 Formwork removal.

.10 Joints.

.11 Provisions to address potential problems such as high winds, monitoring of curing concrete during weekends, breakdown of cold weather heating equipment.

.2 Stating only in the Quality Control Plan that the above items will be done in accordance with specifications is not acceptable.

1.8 SCHEDULING PRODUCTION MATERIALS

.1 All materials and equipment required for protection shall be available at the project site before cold weather concreting.

1.9 INSPECTION AND TESTING

.1 Notify the Engineer at least 24 hours before completed formwork and concrete reinforcement is ready for inspection.

.2 Allow ample time for notification, inspection and corrective work, if required, before scheduling concrete placement.

.3 Concrete sampling, inspection and testing are to be performed by an inspection and testing firm appointed and paid by the Owner.

.4 Provide free access to all portions of work and cooperate with appointed firm.

.5 Submit proposed mix design of each class of concrete to the Engineer for review well before commencement of the work.

.6 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.

.7 Notify the Engineer well in advance of any concrete placement.

.8 Three concrete test cylinders will be taken for every fifty or less cubic metres of each class of concrete placed.

.1 Notwithstanding 1.9.8 (above) additional tests will be taken of concrete placed in critical sections of the work or for small pours as determined by the Engineer from time to time during construction progress.

.9 At least three test cylinders will be taken daily for each class of concrete placed. Record atmospheric and concrete temperatures.

.10 One additional test cylinder will be taken during cold weather concreting and be cured on job site under same conditions as the concrete it represents.

.11 One slump test and one air content test will be taken for each set of test cylinders taken.

.12 Additional slump and air tests may be taken as necessary to verify quality of concrete.

.13 Testing of concrete will be performed in accordance with CSA A23.2. Test results will be issued to the contractor, the supplier, the Engineer and the Owner.

.14 Pay costs for required retesting due to results indicating defective materials or workmanship regardless of the results of the retesting.

.15 If approved by the Engineer, the contractor may arrange and pay for additional tests for use as evidence to expedite construction.

.16 After the completion of the testing procedure, if the Engineer is not satisfied with the indicated quality of the concrete in the structure, the Contractor may be required to strengthen or replace those portions which he deems to be unsatisfactory.

1.10 WASTE MANAGEMENT AND DISPOSAL

.1 Use trigger operated spray nozzles for water hoses.

.2 Designate a cleaning area for tools to limit water use and runoff.

.3 Carefully coordinate the specified concrete work with weather conditions.

.4 Ensure emptied containers are sealed and stored safely for disposal away from children.

.5 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.

.6 Choose least harmful, appropriate cleaning method which will perform adequately.

Part 2 Products

2.1 MATERIALS

.1 Portland cement: Type GU conforming to CSA A3001.

.2 Fine Aggregate: conforming to CSA A23.1.

.3 Coarse Aggregate: conforming to CSA A23.1, Group I, 28 mm, 20 mm to 5 mm or 40 mm to 5 mm.

.4 Ensure that no aggregates are used which may undergo volume change due to alkali reactivity, moisture retention or other causes. Confirm suitability of aggregate with a petrographic analysis if deemed necessary by the Engineer.

.5 Water: to CSA A23.1, clean and free from injurious amounts of oil, alkali, organic matter or other deleterious matter.

.6 Calcium chloride or admixtures containing calcium chloride shall not be used in concrete.

.7 Materials are to be obtained from the same source of supply or manufacturer for the duration of the project. All exposed concrete is to be consistent in colour.

2.2 ADMIXTURES

.1 Air Entrainment: conforming to ASTM C260.

.2 Pozzolanic Material: conforming to CSA A3000.

.3 The use of Fly ash to reduce cement contents is not permitted.

.4 The use of superplasticizers is permitted, however, the admixture must be compatible with air entraining admixture and not cause air void destabilization.

.5 Chemical admixtures: to ASTM C494 and ASTM C1017. Engineer to approve accelerating or set retarding admixtures during cold and hot weather placing.

.6 Silica Fume shall meet all the requirements for Type 'U' material as specified in CSA A3000.

.7 The use of calcium chloride is not permitted.

.8 In all concrete an approved water reducing, cement dispersing agent shall be used which shall reduce the water required for a given slump by not less than 10% and shall give a strength equal to a plain mix with the same cement content at forty-eight hours and 10% greater at seven days. An approved admixture of the water reducing retarding type which is essentially free from chlorides may be used in prestressed concrete.

2.3 CONCRETE MIXES

.1 Proportion concrete in accordance with CSA-A23.1, for foundations, curbs and slabs to the following:

- .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb-b denoted blended) and Portland-limestone cement.
  - .1 Type GU Portland cement
- .2 Concrete Exposure Classes:
  - .1 Concrete on or below grade: Class C-1 unless specified otherwise.
  - .2 Concrete housekeeping pads: Class N.
- .3 Minimum compressive strength at 28 days: 25 MPa for housekeeping pads and 35 MPa for foundation slabs and curbs. (More cement may be required in order to assure that minimum compressive strength is attained. Pay costs of additional cement required in order to assure the minimum compressive strength is attained.)
- .4 Minimum cement content: 340 kg/m^3 of concrete. (Minimum cement content is intended for durability only.)

.5 Maximum water / cement ratio: 0.43. (Maximum w/c ratio is intended for durability only.)

.6 Nominal size of coarse aggregate: 20 mm.

.7 Slump at time and point of discharge: 40 to 85 mm (prior to addition of approved superplasticizer.

.8 Air content: to CSA A23.1, Table 4.

.9 Chemical admixtures: following admixtures in accordance with ASTM C494, type, and quantity.

.2 Pay all costs for mix design. Submit design to the Engineer to review well in advance of any concrete placement.

.3 All admixtures are subject to the approval of the Engineer. List all proposed admixtures in mix design submission. Do not change or add admixtures to approved design mixes without Engineer's approvals.

.4 Provide concrete mixed in accordance with requirements of CSA A23.1.

.5 All Concrete: minimum 28 day compressive strength, cement type, cement content, water cement ratio, nominal coarse aggregate size and maximum slump and minimum slump to be as given.

.6 All Concrete: air content to CSA A23.1 Table 4. If superplasticizer is used, it must be proven compatible with air entraining admixture and shall not cause air void destabilization. Note 3% air content maximum for slabs-on-grade.

2.4 READY MIX CONCRETE

.1 Ready mix concrete shall not be used for the production of precast concrete.

.2 For other than ready mix concrete, either central mixed or transit mixed may be used provided the concrete produced conforms to these Specifications and to the particular requirements of CSA A23.1.

.3 In case of doubt as to the quality of the concrete provided or to be provided by the proposed supplier, the Engineer, at his discretion, may order the contractor not to use concrete on the work from such supplier. The contractor shall arrange for an acceptable concrete supply without additional compensation or extension of time.

2.5 VAPOUR BARRIER

.1 Vapour Barrier: to ASTM E1745, Class B, suitable for use below grade with self-adhesive polyethylene tape for joints. Standard of acceptance: Vapour Block 10 by Raven Industries, Perminator by W.R. Meadows or approved equivalent. Lap joints and repairs minimum 300 mm.

2.6 SHRINKAGE COMPENSATING GROUT (BASEPLATES)

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

.1 Compressive strength: 50 MPa at 28 days. Utilize 'Winter Grade' version of the grout during winter conditions.

.2 Net shrinkage at 28 days: maximum 0.04%.

.3 Standard of acceptance: Sikagrout 212 HP by Sika or Construction Grout by BASF Construction Chemicals.

2.7 PREMOULDED JOINT FILLERS

.1 Premoulded joint fillers or resilient filler:

.1 Bituminous impregnated fiber board: to ASTM D1751.

.2 Sponge rubber: to ASTM D1752, Type 1 sizes as indicated on drawings, 90% + recovery after 50% compression, 380 kPa pressure for 50% compression, Sternson Rodofoam GR, CPD Closed Cell Foam joint Filler or approved equal.

2.8 BACKER ROD

.1 Backer Rod: closed cell vinyl foam.

2.9 JOINT SEALANTS

.1 Joint Sealants: non-staining, non-sagging, grey polyurethane base such as Sikaflex-2c NS/SL or approved equal.

.2 Interior Sawcut Joint or Control Joint Sealant: catalyst cured epoxy rubber, Sternson Loadflex or approved equal.

.3 Primers: as supplied by sealant manufacturers.

2.10 CURING COMPOUNDS

.1 Curing compound to CSA A23.1/A23.2 and ASTM C309, white.

2.11 WATERSTOPS

.1 Waterstops: extruded hydrophilic expansive rubber strips. Acceptable manufacturers:

.1 Swellseal 2010 by DeNeef Construction Chemicals

.2 Hydroflex HF302 by Henry Co.

.3 Akwastop by Volclay.

.4 Or approved equivalent.

2.12 WATERPROOFING COATING

.1 Trench and sump pit waterproofing:

.1 Cem-Kote Flex CR by Gemite or approved equal.

2.13 STRUCTURAL INSERTS

.1 Structural Inserts: stainless steel inserts for bolts, sizes, penetrations and locations as indicated on the drawings. Provide a minimum of 100 mm embedment unless noted otherwise. Install to manufacturer's requirements.

.2 Expansion Anchors: of diameters and penetrations shown on drawings. Capacities are based on Hilti Kwik Bolts. Submit anchor load resistance data from independent testing firm for review of Engineer minimum of two weeks prior to intended use.

.3 Epoxy Inserts: of diameters and penetrations shown on drawings. Capacities are based on Hilti HY150 super hardware. Submit anchor load resistance data from independent testing firm for review of Engineer minimum of two weeks prior to intended use. Use cold weather grade if application temperature is below 10°C.

2.14 ACCESSORIES

.1 Epoxy Bonding Agent: two component, water based, epoxy resin.

.2 Acrylic Bonding Agent: CPD Acrylic Concrete Adhesive, Thorosystems Acryl 60, Sternson, Duraweld C, Elro Flex-Con 710, mixed with cement as recommended by manufacturer.

.3 Non-Ferrous Grout: pre-mixed, non-shrink, Master Builders 713, Sternson M-Bed, CPD Non-shrink grout, Steel CI Grout minimum 35 MPa compressive strength.

Part 3 Execution

3.1 PREPARATION

.1 Before starting this work, examine work done by others which affects this work.

.2 Rectify all conditions which would prejudice proper completion of this work.

.3 Commencement of work implies acceptance of existing conditions.

.4 Coordinate work of this Section with other construction.

.5 Place vapour barrier on top of rigid insulation at underside of concrete slab. Wrap up sides of slab.

.6 Place concrete reinforcing in accordance with Section 03 20 00 – Concrete Reinforcing.

.7 Install all concrete accessories, rock dowels, etc. in accordance with drawings and manufacturer's recommendations, straight, level and plumb.

.8 Obtain Engineer's approval before placing concrete. Provide 48 hours notice prior to placing of concrete.

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

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

.11 During concreting operations development of cold joints not allowed.

.12 Ensure concrete delivery and handling facilities placing with minimum of handling, and without damage to existing structure or Work.

.13 Protect previous Work from staining.

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

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

.16 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with shrinkage compensating grout to anchor and hold dowels in positions as indicated.

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

3.2 CONSTRUCTION

.1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1.

.2 Sleeves and inserts:

.1 No sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by 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 approved by Engineer.

.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain 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.

.3 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.

.3 Formed holes: 100 mm minimum diameter.

.4 Drilled holes: 25 mm minimum diameter larger than bolts used.

.5 Protect anchor bolts from water accumulations, snow and ice build-ups.

.6 Set bolts and fill holes with shrinkage compensating grout.

.7 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.

.4 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.

.5 Waterstops:

.1 Install waterstops to provide continuous water seal per manufacturer's written instructions.

.2 Do not distort or pierce waterstop in such a way as to hamper performance.

.3 Do not displace reinforcement when installing waterstops.

.4 Adequately secure waterstops against displacement during concrete placing using manufacturer’s recommended methods.

.5 Use equipment to manufacturer’s requirements to field splice waterstops.

.6 Use only straight heat sealed butt joints in field.

.7 Use factory welded corners and intersections unless otherwise approved by Engineer.

.8 Protect hydrophilic waterstops from moisture prior to concrete placement.

.6 Joint Fillers:

.1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Engineer.

.2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.3 Locate and form isolation, construction and expansion joints as indicated. Install joint filler.

.4 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

.5 Not less than 28 days after concrete placement, blow out joints with compressed air.

.6 Remove all loose particles, dust, laitance and curing compounds from joints.

.7 Install PVC, polyurethane or polyethylene foam rope joint filler same distance below concrete surface as joint width.

.8 Dry joint surfaces that are damp. Apply recommended primer.

.9 Install sealant in joints in accordance with manufacturer's directions except that primer is to be used in all cases.

.7 Waterproofing Coating

.1 Install coating in strict accordance with manufacturer's written instructions and as specified below.

.2 Prepare concrete surface, removing all loose concrete and deleterious materials using high pressure water.

.3 Repair any defective surfaces and cracks.

.4 Mix and apply coating to saturated surface dry or damp surface.

.5 Apply two coats to achieve a total thickness of 2-3 mm. Apply second coat onto a wet first coat.

.6 Cure minimum 3 days.

3.3 CONCRETE PLACEMENT

.1 Place concrete in accordance with requirements of CSA A23.1 and as indicated on the Drawings.

.2 Notify the Engineer and the inspection and testing firm well in advance of commencement of concrete operations.

.3 Ensure all anchors, seats, plates and other items to be cast into concrete are securely placed and will not interfere with concrete placement. Pay special attention to waterstops; maintain their integrity.

.4 Before placing concrete all equipment for mixing and transporting the concrete shall be cleaned of hardened concrete and foreign materials.

.5 Immediately before concrete is placed all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight, and that all reinforcing steel is in the correct position and secured against movement during the placing operation. All forms shall be thoroughly cleaned and all debris, snow, ice or other foreign material removed. Chemicals shall not be used to remove ice or hardened concrete from the forms. All forms shall be thoroughly soaked with water except in freezing weather.

.6 Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods, which will prevent the separation or loss of the ingredients. Concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling or flowing. Vibrators shall not be used to move concrete. Under no circumstances shall the concrete which has partially hardened be deposited in the forms.

.7 When concreting is started, it shall be carried on as a continuous operation until the placing of the section is completed. When shown on the drawings, concrete shall be placed in the sections indicated and according to the sequence given.

.8 When concrete is placed on an inclined surface, the placing operations shall begin at the lower end of the slope and progress upward; unless otherwise permitted by the Engineer.

.9 Concrete shall be placed in approximately 300 mm to 600 mm horizontal lifts. Lifts shall be consolidated before the next lift is deposited.

.10 The rate of placement shall be such that each successive lift can be vibrated into the previous lift for proper bonding. The rate of concrete placement shall not exceed form designer=s recommendations.

.11 Concrete shall be thoroughly compacted by mechanical vibrators during placing operations. It shall be thoroughly worked around the reinforcement, embedded fixtures and into the corners of the forms.

.12 Vibrate concrete using the appropriate size equipment as placing proceeds in strict accordance with CSA A23.1. Check frequency and amplitude of vibrations prior to use. Provide additional standby vibrators in the event of equipment failure.

.13 Allow vibrator to go into and out of concrete at approximately 90 degree angle. Do not insert or remove at an angle.

.14 Consolidated concrete shall be dense, homogenous and free of cold joints, voids and honeycombing. Concrete shall be bonded to all reinforcing steel, anchors, and embedded parts.

.15 The concrete surfaces shall be protected from rain until the final set occurs.

.16 Maintain accurate records of cast-in-place concrete items. Record date, location of pour, quantity, air temperature and test samples taken.

.17 Ensure reinforcement, inserts, embedded parts, formed expansion and control joints and water stops are not disturbed during concrete placement.

.18 Place concrete continuously between preset construction and control joints.

3.4 CONSTRUCTION JOINTS

.1 Joints not indicated on the Drawings shall be located so as to least impair the strength of the structure. The location of these joints shall be subject to the prior approval of the Engineer. Joints shall be in accordance with CSA A23.1, or as indicated on drawings or direct by the Engineer.

.2 Where the Contractor elects to employ construction joints other than shown and the Engineer so approves, waterstops shall be provided for the full length of the joint if required by the Engineer and without additional compensation to the contractor.

.3 The surface of hardened concrete shall be roughened and thoroughly cleaned of foreign matter and laitance, immediately prior to depositing additional concrete.

3.5 COLD WEATHER CONCRETING

.1 The Contractor shall take special measures over and above those generally described in this Specification during concreting in cold weather. Cold weather, for the purpose of this Specification, is when the air temperature is at or below 5°C, or when the air temperature is likely to fall below this limit within the next twenty-four hours of placing (as forecast by the nearest official meteorological office). In these circumstances, concrete must be heated for placing and then protected from the adverse affects of low temperature.

(This Clause supplements CSA A23-1.)

.2 The contractor shall be fully familiar with the cold weather curing and protection requirements of CSA A23.1 and ACI 306.

.3 Contractor to have equipment for heating materials, for enclosing the freshly deposited concrete and maintaining temperature and humidity during curing on site ready to be put into operation prior to commencing concreting.

.4 When the temperature is at or below 5°C. the mix water shall be heated to the temperature not greater than 65°C which will produce concrete within the specified range at the time of placing.

.5 If the temperature is or was, at any time during the previous twenty four hours, at 0°C., or if the stockpiles of coarse and fine aggregate contain frozen material or are snow covered, then the aggregates as well shall be heated to a temperature of not less than 20°C. nor more than 65°C. The aggregates shall be uniformly heated in the stockpiles and/or bins by steam, either injected, live or circulated in coils or by using dry heat before the aggregates are placed in the mixer. Whatever system is used, it shall be designed to give uniform heating which will avoid local overheating which may be injurious to the materials. That part of the stockpile in use shall be protected with tarpaulins, waterproof paper or plastic sheeting against the formation of ice and the accumulation of snow.

.6 The temperature of the reinforcement and forms shall be above 10°C prior to placing the concrete.

.7 The temperature of the concrete at the time of placing shall be between 10°C and 25°C unless the Engineer directs otherwise in relation to ambient conditions, the type of work and the protective system in use.

.8 The formwork, existing concrete and reinforcing steel against which concrete is to be placed shall be free from ice and snow and above freezing temperature before the Engineer will authorize placing to commence. The contractor shall preheat the area in which the concrete is to be placed when the air temperature is 0°C or below, with live steam or moist hot air; this shall also remove the snow and ice and heat existing concrete to prevent the formation of a cold joint.

.9 Concrete shall not be placed on a frozen subgrade or against frozen ground. The Contractor shall protect and heat excavations prepared for footings and slabs, if required, prior to placing concrete.

.10 The layout of batching and mixing plant and type of handling equipment shall be such that distance and time of transport of mixed concrete before placing is kept to the minimum to avoid heat loss.

.11 The concrete shall be placed rapidly and evenly as near to its final position as possible to reduce the risk of segregation, flow lines and cold joints.

.12 Mix cement and aggregate before adding water. No material including the mix water shall be at a temperature above 65°C. at the time of mixing. The heating water over 40° C. should not be brought into direct contact with the cement but shall be added into the mixer before, with or after the aggregate is placed and the mix turned over a few times to distribute the heat before the cement is added; the prescribed mixing time shall then start.

.13 At no time shall the temperature of the mixed concrete exceed 40°C.

.14 The use of salt, calcium chloride or other chemicals in the mix to lower the freezing point or accelerate the sets is prohibited.

.15 The Contractor shall be responsible for recording air, enclosure air and concrete surface temperatures to ensure compliance. Locations monitored shall include corners and edges. Temperatures should be checked a minimum of twice daily. Copies of records shall be forwarded to Engineer.

.16 Refer to Section 01 50 00 for Temporary Enclosures And Heating Requirements.

3.6 HOT WEATHER CONCRETING

.1 For the purpose of this Specification, hot weather is considered when the temperature is at or above 25°C.

.2 The concrete temperature at the time of placing in hot weather shall not exceed 27°. In the event of the concrete temperature limit being exceeded, the concreting operations shall be suspended until the constituent materials of the concrete are cooled. Aggregate stockpiles may be sprayed with water to give evaporative cooling. The mixing water may be cooled by ice; the ice may be incorporated directly into the concrete as part of the mix water provided it is completely melted by the time the mixing is completed.

.3 Mixing time shall be kept to the minimum time necessary for effective mixing of the concrete.

.4 At no time during the curing period shall the temperature of the concrete exceed 60°C; wherever possible it shall be maintained at the optimum curing temperature of 20°C.

.5 The use of a retarding admixture in hot weather concreting to facilitate placing, finishing and to control temperature rise in the concrete must be approved by the Engineer prior to

use in the work. The amount of retarding admixture added to the concrete shall be the minimum. The actual amount required shall be determined on the basis of the contractor's sequence, speed of placing and finishing operations and other job conditions such as temperature.

.6 Temperature records of concrete placed in hot weather shall be kept together with those of the corresponding air temperature readings. Where required by the Engineer, the contractor shall provide suitable tube inserts in the concrete for thermometers.

3.7 SCREEDING

.1 Screed slabs in accordance with CSA A23.1. Screed level, maintain surface flatness of maximum 3 mm in 3000 mm. Pitch to drains 2% of nominal or as shown on the drawings.

3.8 CONSTRUCTION TOLERANCE

.1 The work shall be carefully and accurately set out; true to the positioning, levels, slopes and dimensions shown on the Drawings but the following may be allowed in the finished structural concrete:

.1 Sizes of Member or Thickness of Slabs: + 6 mm/- 0 mm.

.2 Cover of Concrete over Reinforcement Where Normal Cover is More than 25 mm: ± 3 mm.

.3 Cover of Concrete over Reinforcement Where Normal Cover is 25 mm or less: +6/- 3 mm.

.4 Variations from Flat: 6 mm in 3 m.

.5 Sleeves and Openings in Size and Location: ± 6 mm.

.2 If these tolerances are exceeded the Contractor may, at the discretion of the Engineer, be required to remove and replace or to modify the placed concrete before acceptance.

.3 Allowance must be made for settlement, closure of form joints and elastic shortening of forms and shoring.

3.9 CURING

.1 All concrete shall receive moist curing for a period of at least seventy-two hours. One of the following methods shall be used as soon as the concrete has hardened sufficiently to prevent marring:

.2 Curing types, in accordance with Table 20 of CSA A23.1:

.1 Type 1- Basic, For all concrete except as specified otherwise. Basic curing is defined as curing for a minimum of 3 days at a minimum temperature of 10°C or the time necessary to attain 40% of the specified strength, whichever is greater.

.2 Type 2 – Additional, Additional curing is defined as curing for a minimum of 7 days at a minimum of 10°C or the time necessary to attain 70% of the specified strength, whichever is greater.

.3 Type 3 – Extended. Extended curing is defined as wet curing for a minimum of 7 days.

.3 After curing compound to concrete surfaces immediately after form removal.

.4 Curing compounds shall not be used where bond is required by subsequent topping or coating.

.5 Surface covered with canvas or other satisfactory material and kept thoroughly wet.

.6 Surface sealed with polyethylene sheeting at least 6 mils thick and the concrete kept thoroughly wet.

.7 LIQUID MEMBRANE, CURING COMPOUNDS MAY NOT BE USED.

.8 Surfaces of concrete which are protected by formwork which is left in place for seven days shall not require any additional curing (except as specified for hot weather). If the formwork is removed in less than seven days, the concrete shall receive a moist curing as above or until seven days have elapsed since the concrete was placed; whichever occurs first.

.9 No concreting will be allowed until all materials required for the curing phase are on site and ready for use.

.10 The Contractor shall protect and heat, where necessary, all concrete which has been placed when the air temperature is 5°C. or below. In the opinion of the Engineer, when the air temperature is likely to fall below 5°C. at any time during the twenty-four hours after the concrete is placed, the concrete shall then also be protected and heated, when necessary, from the time the concrete is placed. When the air temperature falls below 5° C. during the seven days after the concrete is placed, the Engineer may instruct the Contractor to institute protection and heating where necessary to prevent damage to the concrete by freezing or to allow the concrete to develop sufficient strength to carry the dead and live loads which will be imposed on it by further construction work or general traffic in the near future.

.11 The system of protection, surface or enclosed with heating, where necessary, (or fully insulated forms). It must be adequate and designed in relation to ambient conditions and the type of construction to satisfactorily achieve these curing conditions in the concrete.

.12 For proper curing of concrete the temperature of all surfaces of the concrete shall be maintained at not less than 20°C, for five days or at not less than 10°C. for seven days after placing. Further, the concrete shall be kept above freezing temperature for a period of at least nine days and shall be kept from alternate freezing and thawing for at least fourteen days after placement.

.13 No salt or other chemicals shall be used to lower the freezing point of the concrete as a substitute for the specified curing and protection.

.14 At the end of the specified protection period, the temperature of the concrete shall be reduced gradually at a rate not exceeding 10°C per day until the outside air temperature has been reached.

.15 The Contractor shall keep a full record of the temperature of concrete upon placing and a daily record of the curing temperature of the concrete for the full protection period.

.16 Concrete which is allowed to freeze or which obtains insufficient curing conditions shall be subject to all necessary investigations and testing as deemed necessary by the Engineer. If found unsatisfactory, all such concrete shall be removed and the portion reconstructed as directed by the Engineer.

.17 The cost incurred by the Engineer for such investigation, testing or inspection of reconstruction and the cost of reconstruction shall be borne by the Contractor.

3.10 DEFECTIVE CONCRETE

.1 All defective concrete less than 30 mm deep including, but not limited to, honeycombing, embedded debris, voids and stone pockets shall be patched within 24 hours of form removal.

.2 Defects shall be removed to sound concrete and to a minimum of 25 mm, leaving edges perpendicular.

.3 Thoroughly wet surface of area to be patched and the surrounding area.

.4 Brush surface of defective area with a 1:1 cement-sand grout mixture.

.5 Patch with 1:1.5 cement-sand mortar with 10% hydrated lime.

.6 Repair tie holes immediately after formwork removal per above defective concrete. Cut back form ties to a minimum depth of 20 mm from the surface of the concrete.

.7 Repair areas deeper than 30 mm with structural repair grout in strict accordance with Manufacturer's written instructions. Submit proposed grout and repair method to Engineer for review prior to undertaking repair.

.8 Modify or replace concrete not conforming to qualities, lines, details and evaluations specified herein or indicated on the Drawings; to the approval of the Engineer.

3.11 SURFACING AND FINISHING

.1 Surface finishes shall be classified as follows:

.1 Class 1 - Ordinary Surface Finish.

.2 Class 4 - Floated Finish.

.2 All concrete shall be given a Class 1 finish except slabs shall be given a Class 4 finish, other finishes shall be as shown on the Drawings.

.3 Class 1 - Ordinary Surface Finish:

.1 Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except those which are not to be exposed or not to be waterproofed. On all surfaces the cavities produced by form ties, if specified to be filled, and all other holes, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned and after having been kept saturated with water for a period of not less than three hours, shall be carefully pointed and trued with the specified mortar. The mortar patches shall be cured as specified under "Curing". All construction and expansion joints in the completed work shall be left carefully tooled and free from all mortar and concrete. The joint filler shall be left exposed for its full length and with clean and true edges. Pointing and patching of concrete surfaces which are to receive a Class 3 finish must be of uniform texture and match the texture of the surrounding formed finishes. An approved acrylic polymer bonding agent shall be used in all repair mortar.

.2 The resulting surfaces shall be true and uniform; all surfaces which cannot be repaired to the satisfaction of the Engineer shall be "rubbed" as specified for Class 2 - Rubbed Finish.

.4 Class 4 - Floated Surface Finish:

.1 Interior floor slabs to be left exposed or to receive epoxy or other surface requiring a smooth surface: initial finishing operations – screeding followed immediately by bull floating or darbying, followed by final finishing comprising mechanical floating and steel trowelling as specified in Section 7.5.4 of CSA A23.1 to produce hard, smooth, dense trowelled surface free from blemishes; finishing tolerance classification: Class A.

.2 After the concrete has been compacted, the surface shall be carefully rodded and struck off with a stroke board to conform to the cross-section and grade shown on the Drawings. Proper allowance shall be made for camber, if required. The strike board may be operated longitudinally or transversely and shall be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither end is raised from the site forms. A slight excess of concrete shall be kept in front of the cutting edge at all times.

.3 After striking off and consolidating, the surface shall be made uniform by longitudinal or transverse floating; or both.

.4 After floating has been completed and the excess water removed, but while the concrete is still plastic, the surface shall be tested for trueness with a straight edge. Any depression found shall immediately be filled with fresh mixed concrete. High areas shall be cut down and refinished. The final surface shall conform to the required grade and contour such that the deviation is not greater than 6 mm under a 3 mm straight edge.

3.12 FIELD QUALITY CONTROL

.1 Site tests: conduct tests as follows and submit report as described in PART 1 – ACTION AND INFORMATIONAL SUBMITTALS.

- .1 Concrete pours.
- .2 Slump.
- .3 Air content.
- .4 Compressive strength at 7 and 28 days.
- .5 Air and concrete temperature.
- .6 Other.

.2 Inspection and Testing of concrete and concrete materials will be carried out by testing laboratory designated by Owner for review to CSA A23.1/A23.2.

.3 Owner will pay for costs of tests.

.4 Contractor will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.5 Non-destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

.6 Inspection or testing by Designated Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.13 CLEAN-UP

.1 As work progresses, remove from site all debris and excess materials.

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

.3 Do not dispose of unused admixtures and additive materials into sewer system, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

.4 Prevent admixtures and additive materials from entering drinking water supplies or streams.

.5 At completion of work, remove from site all debris, excess materials and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 05 21 00 – Steel Joist Framing.

.2 Section 05 31 00 – Steel Decking.

.3 Section 09 91 23 – Painting

1.2 SCOPE OF WORK

.1 This section shall be responsible for all labour, plant, tools, equipment and materials necessary for the supply and installation of all structural steel indicated on the drawings.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM International)

- .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
- .2 ASTM A123/A123M-15, Standard Specification for Zinc Hot Dip Galvanized Coatings on Iron and Steel Products.
- .3 ASTM A536-15, Standard Specification for Carbon and Alloy Steel Nuts.
- .4 ASTM F436-11, Standard Specification for Hardened Steel Washers.
- .5 ASTM F1554-15e1, Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
- .6 ASTM F3125/F3125M-15a, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).

- .1 Handbook of the Canadian Institute of Steel Construction.
- .2 CISC/CPMA 2 -75, Quick Drying, Primer for use on Structural Steel.

.3 Canadian Standards Association (CSA International)

- .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA S16-14, Design of Steel Structures.
- .3 CSA S136-16, North American Specifications for the Design of Cold Formed Steel Structural Members.
- .4 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel.
- .5 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
- .6 CSA W55.3-08(R2013), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .7 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

.4 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International

.1 SSPC SP-1, Solvent Cleaning.

.2 NACE No. 3/SSPC SP-6, Commercial Blast Cleaning.

1.4 QUALIFICATIONS

.1 The contractor performing the work under this section shall ensure that:

.1 Each welder shall have a minimum of five (5) years proven satisfactory experience in structural steel welding.

.2 Have adequate equipment and skilled personnel to expediently complete this work.

.2 All welding is to be performed by a firm certified by the Canadian Welding Bureau to the requirements of CSA W47.1, Division 1 or 2.

.3 Submit documentation and proof of Canadian Welding Bureau certification to Engineer four (4) weeks prior to commencing fabrication.

.4 The Fabricator shall have established and audited engineering capability, provided by a registered engineer or engineers, employed an a full time basis or retained on a contractual basis, to provide the engineering necessary for the preparation of shop details and erection diagrams, and to establish engineering practices in order to maintain standards as set forth, and also to be responsible for any structural design when undertaken.

.5 Submit letter to Engineer stating the fabricator's engineering capability within two weeks after award of contract.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop Drawings:

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Territory of Nunavut, Canada.

.2 All shop drawings shall be detailed using S.I. (metric) units.

.3 Clearly indicate shop and erection details including cuts, copes, connections, holes, threaded fasteners, rivets and welds. Indicate welds by CSA W59 welding symbols. For bolted connections indicate by special note if slip-resistant (friction-type) connections have been used.

.4 Shop drawing review by Engineer is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the contractor submitting same, and such review shall not relieve the contractor of his responsibility for errors or omissions in the shop drawings or if his responsibility for meeting all requirements of the construction and contract documents. The contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the work of all subtrades.

.3 Erection drawings:

.1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:

.1 Description of methods.

.2 Sequence of erection.

.3 Type of equipment proposed for use in erection.

.4 Temporary bracings.

.2 This submission or its approval shall not relieve the contractor of his responsibility for providing proper methods, equipment, workmanship and safety precautions.

.4 Fabrication drawings:

.1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the Territory of Nunavut, Canada.

.5 Source Quality Control Submittals:

.1 Upon request submit copies of mill test reports 4 four weeks prior to fabrication of structural steel.

.1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.

.2 Mill test reports to be certified by metallurgists qualified to practice in Territory of Nunavut, Canada.

.6 Submit primer/paint colour samples 4 weeks prior to fabrication of structural steel.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CSA S16 and CSA S136 to resist forces, moments, and shears and allow for movements indicated.

.2 Detail and reinforce all slots, holes and openings in members so as to avoid overstressing. Construct re-entrant corners free from notches and with largest practical radii, with a minimum radius of 12 mm.

.3 Grind smooth or detail all butt welds, connections and splices in members, which will be exposed when construction is complete, so as to be as unobtrusive as possible. Appearance of splices, location and details to Consultant’s approval.

.4 Detail sloping beams to permit level bearing at each support unless specifically indicated otherwise.

.5 Shear connections:

.1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.

.2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.

.6 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Territory of Nunavut, Canada for non standard connections.

2.2 MATERIALS

.1 Structural steel: to CSA G40.20/G40.21, rolled shapes Grade 350W; hollow structural sections Grade 350W, Class C or ASTM A500 Grade C; channels, angles, rods and plates Grade 300W.

.2 Cold formed purlins and girts: To CSA S136, Grade 345, as produced by Canam or equal. Sizes as indicated on drawings.

.3 Anchor rods: to CSA-G40.20/G40.21, Grade 300W complete with ASTM A563 nuts and ASTM F436 circular washers.

.4 Bolts, nuts and washers: to ASTM F3125/F3125M.

.5 Welding materials: to CSA W59, E480XXCH or LH electrodes conforming to CSA W48 and certified by Canadian Welding Bureau.

.6 Shop primer/paint: Low VOC, high solids, fast curing epoxy primer/finish. Acceptable products:

.1 Intergard 670 by International Protective Coatings.

.2 Maxopoxy 670 by Sherwin Williams.

.3 Amercoat 370 by Ameron.

.4 Or approved equal.

.7 Hot dip galvanizing: galvanize steel, where indicated to ASTM A123/A123M, minimum zinc coating of 600 g/m^2.

2.3 FABRICATION

.1 Fabricate structural steel in accordance with CSA S16 and CSA S136 and in accordance with reviewed shop drawings.

.2 Continuously seal members by continuous welds. Grind smooth.

.3 Reinforce openings to maintain desired strength. All reinforcing to be shown on shop drawings.

.4 Provide welded cap plates, minimum 10 mm thickness unless noted otherwise, to open ends of all HSS Sections. Seal weld for water tightness.

.5 Minimum fillet weld size 6 mm.

2.4 SHOP PAINTING

.1 Clean, prepare surfaces and shop prime structural steel in accordance with manufacturer’s written instructions.

.2 Do not prepare any exposed steel substrate for the application of protective coatings maximum 24 hours prior to the actual application of protective coatings.

.3 Clean members; remove loose mill scale, rust, oil, dirt and foreign matter in accordance with SSPC-SP1 Solvent Cleaning.

.4 Prepare surface according to NACE NO. 3/SSPC-SP-6 (Commercial Blast Cleaning) prior to shop primer/paint.

.5 Use only those thinners recommended by and made by the Coating Manufacturer. Substitutes may only be used with the prior written approval from the Coating Manufacturer.

.6 Hand stripe coat of primer/paint to all leading edges, corners and welds to be prior to spray application of primer.

.7 Apply one coat of primer/paint in shop to steel surfaces to achieve minimum dry film thickness of 4.0-6.0 mils on all surfaces, except:

.1 Surfaces to be encased in concrete.

.2 Surfaces and edges to be field welded.

.8 Apply paint, under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.

.9 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

.10 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

.1 Structural steel work: in accordance with CSA S16 and CSA S136.

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.3 MARKING

.1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

.2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.4 ERECTION

.1 Erect structural steel, as indicated and in accordance with CSA S16, CSA S136 and in accordance with reviewed erection drawings.

.2 Field cutting or altering structural members: to approval of Engineer.

.3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.5 FIELD QUALITY CONTROL

.1 If required, inspection and testing of materials and workmanship shall be carried out by testing laboratory designated and paid for by Owner.

.2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Engineer.

.3 Submit test reports to Engineer within 1 week of completion of inspection.

3.6 FIELD PAINTING

.1 Paint in accordance with Section 09 91 23 - Painting.

.2 Touch up damaged surfaces and surfaces without shop coat with primer to SSPC-SP-6 except as specified otherwise.

.3 Spot paint field welds, bolts, scratches, burns and abrasions with primer.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA)

.1 CISC/CPMA 2-75, Quick-Drying, Primer for Use on Structural Steel.

.2 Canadian Standards Association (CSA International)

.1 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA-S16-14, Design of Steel Structures.

.3 CSA-S136-16, North American Specification for the Design of Cold Formed Steel Structural Members.

.4 CSA-W47.1-09(R20143), Certification of Companies for Fusion Welding of Steel.

.5 CSA-W55.3-08(R2013), Certificate of Companies for Resistance Welding of Steel and Aluminum.

.6 CSA-W59-13, Welded Steel Construction (Metal Arc Welding).

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 steel joist framing and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Territory of Nunavut, Canada.

.2 Indicate on erection drawings, relevant details such as joist mark, depth, spacing, bridging lines, bearing, anchorage and details.

.3 Indicate particulars on shop drawings, relative to joist geometry, framed openings, splicing details, bearing and anchorage. Include member size, properties, specified and factored member loads, and stresses under various loadings, deflection and camber.

.4 Delegated Design Submittals:

.1 Submit copies of calculations and joist design drawings for typical joists to Departmental Representative for review at least 4 weeks prior to fabrication and/or delivery.

1.3 QUALITY ASSURANCE

.1 Submit copies of mill test reports at least 4 weeks prior to fabrication of steel joists and accessories if requested. Reports to show:

.1 Chemical and physical properties.

.2 Other details of steel to be incorporated into work.

.3 Certification by qualified metallurgists confirming that tests conform to requirements of CSA-G40.20/G40.21

.2 Submit affidavit prepared by fabricator of structural steel joists stating that materials and products used in fabrication conform to this specification.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

Part 2 - Products

2.1 DESIGN CRITERIA

.1 Design steel joists and bridging to carry loads indicated in joist schedule shown on drawings to CSA-S16.

.2 Design joists and anchorages for uplift forces as indicated.

.3 Ensure joists are manufactured to consider load effects due to fabrication, erection and handling.

.4 Limit roof joist deflection due to specified live load to 1/360 maximum of span and deflection due to specified total load to 1/240 maximum of span.

2.2 MATERIALS

.1 Open web steel joists: to CSA-S16.

.2 Structural steel: to CSA-G40.20/G40.21.

.3 Welding materials: to CSA-W59.

.4 Shop paint primer: to CISC/CPMA-2.

2.3 FABRICATION

.1 Fabricate steel joists and accessories as indicated in accordance with CSA-S16 and in accordance with reviewed shop drawings.

.2 Weld in accordance with CSA-W59.

.3 Provide diagonal and horizontal bridgings and anchorages as indicated.

2.4 SHOP PAINTING

.1 Clean, prepare and shop prime surfaces of steel joists to CSA-S16 and SSPC SP6.

.2 Clean members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces to SSPC SP1 brush blast.

.3 Apply one coat of CISC/CPMA 2 primer to steel surfaces to achieve dry film thickness of .065 mm to .080 mm maximum except:

.1 Surfaces to be encased in concrete.

.2 Surfaces to receive field installed stud shear connectors and steel decks.

.3 Surfaces and edges to be field welded.

.4 Faying surfaces of friction-type connections.

.5 Below grade surfaces in contact with soil.

.4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.

.5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

.6 Strip paint bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 - Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for steel joist framing installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative 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 from Departmental Representative.

3.2 INSTALLATION

.1 Do structural steel work: to CSA-S16.

.2 Do welding: in accordance with CSA-W59.

.3 Ensure installers are certified to CSA-W47.1 for fusion welding and CSA-W55.3 for resistance welding.

.4 Submit certification that welded joints are qualified by Canadian Welding Bureau.

3.3 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing work; report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.

3.4 FIELD QUALITY CONTROL

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.

.2 Testing laboratory will inspect representative joists for integrity, accuracy of fabrication and soundness of welds. Testing laboratory will also monitor test loading of joists used by manufacturer to verify design and check representative field connections. Departmental Representative will determine extent of and identify all inspections.

.3 Submit test report to Departmental Representative within 7 days after completion of inspection.

.4 Departmental Representative will pay costs of tests as specified in Section 01 29 83 - Payment Procedures: Testing Laboratory Services.

3.5 ERECTION

.1 Erect steel joists and bridging as indicated to CSA-S16 and in accordance with reviewed erection drawings.

.2 Complete installation of bridging and anchorages before placing construction loads on joists.

.3 Field cutting or altering joists or bridging that are not shown on shop drawings: to approval of Departmental Representative.

.4 Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.

3.6 FIELD PAINTING

.1 Paint: in accordance with Section 09 91 23 - Interior Painting.

.2 Touch up all damaged surfaces and surfaces without shop coat with CISC/CPMA-2 in accordance with manufacturers' recommendations.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel joist framing installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA International)

.1 CSA-S16-14, Design of Steel Structures.

.2 CSA-S136-12, North American Specification for the Design of Cold Formed Steel Structural Members.

.3 CSA-W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel Structures.

.4 CSA-W55.3-08(R2013), Certification of Companies for Resistance Welding of Steel and Aluminum.

.5 CSA-W59-13, Welded Steel Construction, (Metal Arc Welding).

.4 Canadian Sheet Steel Building Institute (CSSBI)

.1 CSSBI 10M-08, Standard for Steel Roof Deck.

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 steel decking and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Territory of Nunavut, Canada.

.2 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect decking from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, and uplift as indicated.

2.2 MATERIALS

.1 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.

.2 Zinc (Z) coated steel sheet: to ASTM A653/A653M structural quality Grade [230] [255], with ZF75, coating, regular spangle surface, [chemically treated for unpainted finish,] [not chemically treated for paint finish,] _] mm minimum base steel thickness.

.3 Closures: in accordance with manufacturer's recommendations.

.4 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.76 mm minimum. Metallic coating same as deck material.

.5 Primer: zinc rich, ready mix to CAN/CGSB-1.181.

.1 VOC limit [250] [350] g/L maximum.

.6 Caulking: to Section 07 92 00 - Joint Sealants.

2.3 TYPES OF DECKING

.1 Steel roof deck:] mm minimum base steel thickness, 38 mm maximum deep profile, [non-cellular] [cellular], interlocking side laps.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for steel decking installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative

.2 Inform Departmental Representative 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 from Departmental Representative.

3.2 INSTALLATION

.1 Structural steel work: in accordance with CSA-S136 and CSSBI 10M.

.2 Welding: in accordance with CSA-W59, except where specified otherwise.

.3 Companies to be certified under Division 1 or 2.1 of CSA-W47.1 for fusion welding of steel and/or CSA-W55.3 for resistance welding.

3.3 ERECTION

.1 Erect steel deck as indicated and in accordance with CSA-S136, CSSBI 10M and in accordance with reviewed erection drawings.

.2 Lap ends: 100 mm minimum.

.3 Fasten deck to supporting steel with self drilling screws spaced at 300 mm o.c. maximum.

.4 Fasten deck side overlays with stich screws spaced at 300mm o.c. maximum.

.5 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.

3.4 CLOSURES

.1 Install closures in accordance with approved details.

3.5 OPENINGS AND AREAS OF CONCENTRATED LOADS

.1 No reinforcement required for openings cut in deck which are smaller than 150 mm square.

.2 Frame deck openings with any one dimension between 150 to 300 mm as recommended by manufacturer, except as otherwise indicated.

.3 For deck openings with any one dimension greater than 300 mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.

3.6 CLEANING

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel decking installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 61 00 – Sheet Metal Roofing.

.2 Section 09 22 16 – Non-Structural Metal Framing.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM International)

- .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .4 ASTM A879/A879M-12(2017), Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.

.2 Canadian Standards Association (CSA International)

- .1 CSA S136-16, North American Specification for the Design of Cold Formed Steel Structural Members.
- .2 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel Structures.
- .3 CSA W55.3-08(R2013), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .4 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

.3 Canadian Sheet Steel Building Institute (CSSBI)

- .1 CSSBI Fact Sheet #3 February 2006, Care and Maintenance of Prefinished Sheet Steel Building Products.
- .2 CSSBI Technical Bulletin Vol. 7, No. 2 September 2011, Standard Thicknesses for Canadian Lightweight Steel Framing Applications.

.4 Master Painters Institute (MPI)

- .1 Architectural Painting Specification Manual - current edition.

.5 National Building Code of Canada 2015 (NBCC).

1.3 DESCRIPTION OF SYSTEMS

.1 Wind bearing stud systems includes:

- .1 Wall studs subjected to lateral loads. No axial load other than self weight and weight of applied finishes.
- .2 Steel bridging.
- .3 Top and bottom tracks.
- .4 Head and sill members and jamb studs for all wall openings.

.5 Stud, bridging and track connections.

.6 Top and bottom track connections to main structure including detailing to accommodate roof deflections.

.7 Connection to intermediate structural girts.

.2 Snow and wind bearing roof joist systems includes:

.1 Roof joists subjected to snow load and wind loads.

.2 Steel bridging.

.3 Upper and lower rim tracks.

.4 Metal hat sections.

.5 Framing and connections for all roof openings.

.6 Joist, bridging, connections.

1.4 DESIGN CRITERIA

.1 Design components based on Limit States principals using factored loads and resistancesstructural design criteria indicated on drawings.

.2 Determine factored loads, combinations and resistances in accordance with NBCC and CSA S136.

.3 Conform to requirements of specified fire rated assemblies.

.4 Deflection criteria under specified loads:

.1 Wall studs: L/360.

.2 Roof joists: L/360.

.5 Splices:

.1 No splices permitted in studs or joists.

.2 Splices are permitted in bridging. Show splice detail on shop drawings.

.6 Design bridging, connections and anchorages to prevent member rotation and member translation.

.7 Design components and assemblies to accommodate specified erection tolerances of the structure.

.8 Allow for movement of the structure at top of wall studs. Design end connections to accommodate vertical deflection movement of the structure without imposing axial loads onto the framing.

.9 Make connections between lightweight steel framing members using bolts, sheet metal screws or by welding.

.10 Maximum spacing of wall studs: 400 mm o.c.

.11 Double (nested) track system required at top of walls.

.12 Stud and joist depths, maximum spacing and minimum thicknesses are shown on drawings. Adjust joist material thickness and spacing as required by design criteria.

.13 Base the resistance for sheet metal screws on manufacturer’s lower bound test values multiplied by appropriate resistance factor φ_c, given in CSA S136.

1.5 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 structural metal studs and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Calculations:

.1 Submit engineering calculations or data verifying capacity of members and ability of assemblies to meet design requirements

.4 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Territory of Nunavut, Canada.

.2 Indicate design loads, member sizes, materials, design thickness exclusive of coatings, coating specifications, connection and bracing details, screw sizes and spacing, and anchors.

.3 No splices allowed in studs.

.4 Include manufacturer’s data sheets for anchors, angle clips, etc.

.5 Indicate locations, dimensions, openings and requirements of related work.

.6 Indicate welds by welding symbols as defined in CSA W59.

.5 Certificates: Upon request submit two (2) certified copies of mill reports covering material properties.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions. Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect structural metal studs from nicks, scratches, and blemishes.

.3 Protect steel studs during transportation, site storage and installation in accordance with CSSBI Sheet Steel Facts #3.

.4 Handle and protect galvanized materials from damage to zinc coating.

.5 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Steel: to CAN/CSA S136, fabricated from ASTM A653/A653M, and identified as to specification, type, grade and mechanical properties. Minimum steel thickness, exclusive of coating as determined by steel stud framing engineer.

.2 Zinc coated steel sheet: quality to ASTM A653/A653M, with Z275 designation coating.

.3 Members forming part of exterior building envelope shall have a minimum coating of Z180 galvanizing in accordance with ASTM A653/A653M. Other coatings, such as aluminum-zinc alloy, providing equal or better corrosion protection may be used.

.1 Interior members not forming part of exterior building envelope shall have a minimum coating of Class C electrogalvanizing in accordance with ASTM A879/A879M. Other coatings, such as electro-deposited zinc, chromate treated, zinc-iron alloy or aluminum-zinc alloy, providing equal or better corrosion protection may be used.

.2 Sheet metal screws shall have a minimum coating thickness of 0.008 mm of zinc or cadmium. Other coatings providing equal or better corrosion protection may be used.

.4 Welding materials: to CSA W59; 480 minimum tensile strength series (e.g., E49XX).

.5 Screws: self-drilling, self-tapping sheet metal screws, corrosion protected with minimum zinc coating thickness of 0.008 mm, length as required by design.

.6 Anchors: concrete expansion anchors or other suitable drilled type fasteners.

.7 Bolts, nuts, washers: hot dipped galvanized to ASTM A123/A123M, 600 g/m^2 zinc coating.

.8 Touch up primer: zinc rich, to CAN/CGSB-1.181.

2.2 STEEL STUD DESIGNATIONS

.1 Colour code: to CSSBI Technical Bulletin Vol.7, No. 2.

2.3 METAL FRAMING

.1 Roof joists: to CAN/CSA S136, fabricated from metallic coated steel, depth as indicated.

.1 Minimum steel thickness of 1.37 mm.

.2 Stud tracks: fabricated from same material and finish as steel studs, depth to suit.

.1 Bottom track: single piece.

.2 Top track: 2 piece telescoping.

.3 Bridging: fabricated from same material and finish as studs, 38 x 12 x 1.09 mm minimum thickness.

.4 Angle clips: fabricated from same material and finish as studs, 38 x 38 mm x depth of steel stud, 1.37 mm minimum thickness.

.5 Tension straps and accessories: as recommended by manufacturer.

2.4 FABRICATION

.1 Do not fabricate until shop drawings are reviewed.

.2 Cutting of members may be by saw or shear. Torch cutting is not permitted.

.3 Fabrication tolerances for members shall be as follows:

Member	Member	Flange	Lip	Thickness	Inside	Corner

Type	Depth A (mm)	Width B (mm)	Length C (mm)	T (mm)	Radius r (mm)	Angles
Track, stud joist or rafter	-1, +2	-1, +2	-0, +4	-0		+30

.4 Mark steel thickness, exclusive of coating, on each member by embossing, stamping with indelible ink or by colour coding.

2.5 SOURCE QUALITY CONTROL

.1 Ensure mill reports covering material properties are reviewed by Engineer.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable.

.1 Visually inspect substrate.

.2 Inform Engineer 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 from Engineer.

3.2 FASTENERS AND WELDS

.1 Insure that connected parts are in contact. Provide clamping before welding or installing screws as required.

.2 Diameter of steel screws shall equal or exceed minimum diameter indicated on shop drawings.

.3 Ensure screw penetration beyond joined materials is not less than 3 exposed threads.

.4 Thread types and drilling capability shall conform to manufacturer's recommendations.

.5 Screws covered by sheathing materials shall have low profile heads.

.6 Weld in accordance with CSA W59.

.7 Certification of companies: to CSA W47.1 for fusion welding and CSA W55.3 for resistance welding. Welders shall be qualified for base material types and thicknesses being welded.

.8 Touch-up welds and coatings damaged by welding with zinc rich paint. Prior to touching-up prepare surface in accordance with paint manufacturer’s recommendations.

3.3 ERECTION

.1 Erect components to requirements of reviewed shop drawings.

.2 Anchor tracks securely to structure at 800 mm on centre maximum, unless lesser spacing prescribed on shop drawings.

.3 Erect studs plumb, aligned and securely attached with 2 screws minimum, welded in accordance with manufacturer's recommendations.

.4 Seat studs into bottom tracks and 2 piece telescoping top track.

.5 Install 50 mm minimum telescoping track at top of walls where required to accommodate vertical deflection.

.1 Nest top track into deflection channel minimum of 30 mm and maximum of 40 mm.

.2 Do not fasten tracks together.

.3 Stagger joints.

.6 Install studs at not more than 50 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.

.7 Brace steel studs with horizontal internal bridging at 1200 mm maximum.

.1 Fasten bridging to steel clips fastened to steel studs with screws or by welding.

.8 Frame openings in stud walls to adequately carry loads by use of additional framing members and bracing as detailed on shop drawings.

.9 Erect joists aligned and securely attached with 2 screws minimum, welded in accordance with manufacturer’s recommendations.

.10 Frame openings in roof to adequately carry loads by use of additional framing members and bracing as detailed on shop drawings.

.11 Touch up welds with coat of zinc rich primer.

3.4 ERECTION TOLERANCES

.1 Plumbness: not to exceed 1/500th of member length.

.2 Straightness (camber and sweep): not to exceed 1/1000th of member length.

.3 Spacing: not more than +/- 3 mm from design spacing. Cumulative error in spacing shall not exceed requirements of finishing materials.

.4 Gap between end of stud and track web: not more than 4 mm.

3.5 CUTOUTS

.1 Provide cutouts centered in webs of members to accommodate services.

.2 Maximum size of cutouts for services as follows:

Member Depth	Across Member Depth	Along Member Length	Centre to Centre Spacing (mm)
92	40 max.	105 max.	600 min.
102	40 max.	105 max.	600 min.

Member Depth	Across Member Depth	Along Member Length	Centre to Centre Spacing (mm)
152	65 max.	115 max.	600 min.

.3 Limit distance from centerline of last unreinforced cut out to end of member to less than 300 mm.

3.6 CLEANING

.1 Progress Cleaning: leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by structural metal stud installation.

3.8 INSPECTION

.1 Steel stud framing design engineer, responsible for the production of shop drawings, shall provide periodic field review during construction and shall submit reports in accordance with Article 1.8.

.1 Contractor shall pay for field review.

.2 Additional inspection and testing of materials and workmanship will be carried out by a qualified independent inspection agency as specified under Section 01 45 00 - Quality Control.

.1 Inspection shall include:

.1 Checking that mill test reports are properly correlated to materials.

.2 Sampling fabrication and erection procedures for general conformity to requirements of specification.

.3 Checking that welding conforms to requirements of Article 3.2.

.4 Checking fabricated members against specified member shapes.

.5 Visual inspection of welded connections including sample checking of joint preparation and fit-up.

.6 Sample checking of screwed and bolted joints.

.7 Sample checking that tolerances are not exceeded during fit-up or erection.

.8 Additional inspection and testing of welded connections as required by CSA W59.

.9 General inspection of field cutting and alterations required by other trades.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)

- .1 ANSI/NAAMM MBG531-09, Metal Bar Grating Manual.
- .2 AMP 510-92, Metal Stair Manual (latest edition).

.2 American Society for Testing and Materials (ASTM International)

- .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
- .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .3 ASTMA123/A123M-15, Standard Specification for Zinc Hot Dip Galvanized Coatings on Iron and Steel Products.
- .4 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .5 ASTM F3125/F3125M-15a, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.3 Canadian General Standards Board (CGSB).

- .1 CAN/CGSB-1.181-99, Ready Mixed Organic Zinc-Rich Coating.

.4 Canadian Standards Association (CSA International)

- .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA S16-14, Design of Steel Structures.
- .3 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
- .4 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.6 The Master Painters Institute (MPI)

- .1 Architectural Painting Specification Manual - current edition.

.7 National Association of Architectural Metals Manufacturers(NAAMM).

- .1 Metal Stairs Manual, 5th edition (1992).

.8 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International

- .1 SSPC SP-1, Solvent Cleaning.
- .2 NACE No. 3/SSPC SP-6, Commercial Blast Cleaning.

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 sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 20 - Health and Safety Requirements.

.1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Territory of Nunavut, Canada.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, size and number of anchors or fasteners, supports, reinforcement, profiles, sizes, attachments, details, and accessories.

.3 Include erection drawings, elevations and details where applicable.

.4 Indicate welded connections using CISC standard welding symbols. Clearly indicate new weld lengths.

1.3 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Welding work on all load carrying structures and assemblies is to be performed by a firm certified by the Canadian Welding Bureau to the requirements of CSA W47.1 Division 2.1.

.4 All welders employed to weld load carrying structures in the field are to possess valid “S” Classification Class “O” certificates issued by the Canadian Welding Bureau.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packing, Shipping, Handling and Unloading:

.1 Deliver, store and handle materials in accordance 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 Protection:

.1 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

.2 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.4 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Steel rolled sections: to CSA G40.20/G40.21, Grade 350W.

.2 Steel rods and plates: to CSA G40.20/G40.21, Grade 300W.

.3 Steel tubing: to CSA G40.21/G40.21, Grade 350W, Class C or ASTM A500 Class C.

.4 Steel pipe: to ASTM A53/A53M, Grade 241 MPa, standard weight, schedule 40 seamless black.

.5 Safety Grating: to ANSI/NAAMM MBG 53 Deck span by Fisher & Ludlow or approved equal.

.1 Metal grating: Type 30-102, 32 x 4.8 bearing bars, serrated surface, galvanized by Fisher-Ludlow or approved equal. All edges banded. Stair treads with checker plate nosing.

.6 Welding materials: to CSA W59.

.7 Welding electrodes: to CSA W48 Series.

.8 High strength bolts: to ASTM F3125/F3125M.

.9 Anchor bolts: to ASTM A36/A36M complete with ASTM A563 nuts and ASTM F436 circular washers.

.10 Adhesive anchors: Acceptable products:

.1 HIT HY 200 by Hilti.

.2 Epcon A7 by Red Head.

.11 Screws: Tamper-resistant: self tapping, round or pan head, fabricated of 18-8 stainless steel; one-way or other tamper-resistant style approved by Engineer.

.12 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

.1 Verify all dimensions on site prior to shop fabrication.

.2 Fabricate items of sizes and profiles detailed on drawings, with joints neatly fitted and properly secured.

.3 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.4 Fit and shop assemble work in largest practical sections, for delivery to site ready for erection.

.5 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts.

.6 Supply all components required for proper anchorage of miscellaneous metals. Fabricate anchorage and related components of same colour and finish as base material on which they occur, unless specified or shown.

.7 Accurately form all connections and joints with exposed faces flush, mitres and joints tight.

.8 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds and metal sections smooth and flush.

.9 Provide for flush welded or hairline butt field joints.

.10 Provide lugs, clips, brackets, hangers and struts as required for attaching miscellaneous metal items securely to building structure.

.11 Where possible, fit and shop assemble work, ready for erection.

.12 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

.13 Separate dissimilar metals to prevent galvanic corrosion using fibrated paint.

.14 Thoroughly clean all surfaces of rust, scale, grease and foreign matter prior to galvanizing.

2.3 SHOP PAINTING

.1 Clean, prepare surfaces and shop prime structural steel in accordance with manufacturer's written instructions.

.2 Do not prepare any exposed steel substrate for the application of protective coatings maximum 24 hours prior to the actual application of protective coatings.

.3 Clean members; remove loose mill scale, rust, oil, dirt and foreign matter in accordance with SSPC-SP1 Solvent Cleaning.

.4 Prepare surface according to NACE NO. 3/SSPC-SP-6 (Commercial Blast Cleaning) prior to shop primer/paint. Blast profile shall be at least 50 microns and not more than 75 microns.

.5 Apply one coat of primer/paint in shop to steel surfaces to achieve minimum dry film thickness of 4.0 – 6.0 mils, except:

.1 Surfaces to be encased in concrete.

.2 Surfaces and edges to be field welded.

.6 Apply paint, under cover, on dry surfaces, free from rust, scale and grease when surface and air temperatures are above 5 degrees C.

.7 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.

.8 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

2.4 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2 to CAN/CSA-G164.

.2 Shop primer/paint: Low VOC, high solids, fast curing epoxy primer/finish. Acceptable products:

.1 Intergard 670 by International Protective Coatings.

.2 Maxopoxy 646 by Sherwin Williams.

.3 Amercoat 370 by Ameron.

.4 Or approved equal.

.3 Zinc primer: zinc rich, ready mix.

2.5 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.

.2 Concrete, mortar and masonry.

.3 Wood.

2.6 GRATING

.1 Galvanized steel gratings to be supplied in 1200 mm removable lengths unless detailed otherwise.

2.7 ACCESS LADDERS

.1

2.8 BOLLARDS

.1 Fabricate bollards from extra heavy pipe. Hand over to Section 03300 for installation into concrete.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.

.1 Inform Engineer of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 ERECTION

.1 Obtain Engineer’s permission prior to site cutting or making adjustments that are not part of scheduled work.

.2 Do welding work in accordance with CSA W59 unless specified otherwise.

.3 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections. Maintain free from distortion or defects detrimental to appearance and performance.

.4 Make provision for erection stresses and temporary bracing. Keep work in alignment at all times.

.5 Replace items damaged in course of installation.

.6 Perform necessary cuttings and altering for the installation of work of other sections, and as indicated on drawings. No additional cutting is to be done without the approval of the Engineer.

.7 Perform all field assembly bolting and welding to match standard of shop bolting and welding to CSA S16. Bolts and screws are to be concealed, whenever possible.

.8 Provide suitable means of anchorage acceptable to Engineer such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.9 Exposed fastening devices to match finish and be compatible with material through which they pass.

.10 Supply components for work by other trades in accordance with shop drawings and schedule.

.11 Make field connections with bolts to CSA S16.

.12 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.13 Touch-up field welds, bolts and burnt or scratched surfaces with primer.

.14 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

3.3 ACCESS LADDERS

.1 Install access ladders in locations as indicated.

3.4 CLEANING

.1 Perform cleaning after installation to remove construction and accumulated environmental dirt.

.2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 05 41 00 – Structural Metal Stud Framing

.2 Section 07 21 20 – Insulation

.3 Section 07 46 50 – Preformed Metal Cladding/Siding

.4 Section 07 61 00 – Sheet Metal Roofing

1.2 SECTION INCLUDES

.1 The requirements for the application of water repellents for exterior surfaces.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM International)

.1 ASTM E96/E96M-16, Standard Tesyt Methods for Water Vapor Transmission of Materials.

.2 ASTM F1667-13, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 51.33-M89, Vapour Barrier.

.2 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 Canadian Roofing Contractors Association (CRCA)

.1 Manual on Good Roofing Practice.

1.4 SUBMITTALS

.1 Submit manufacturer's product data and installation instructions in accordance with Section 01 33 00 – Submittal Procedures.

1.5 SITE CONDITIONS

.1 Site Environmental Requirements:

.1 Maintain rolls at a temperature not less than 5°C until application.

.2 Do not apply membrane during conditions of rain, snow or other precipitation.

Part 2 Products

2.1 MATERIALS

.1 Self Adhering Air/Vapour Barrier Membrane for walls and roof composed of SBS modified bitumen and a polyester woven complex on the top surface: Acceptable product: Soprema Sopraseal Stick 1100T or approved equal.

.2 Vapour Permeable Weather Barrier for walls: Acceptable product Dupont TYVEK commercial wrap or approved equal.

.3 Accessories: primer for surfaces to receive vapour barrier, acceptable product Soprema Elastocol Stick or Elastocol Stick H20.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept the Work of this section.

.2 Ensure surfaces are clean of oil and excess dust, and concrete surfaces free of large voids, spalled areas or protrusions.

.3 Ensure substrates are free of surface moisture prior to application of self-adhesive membrane and primer.

.4 Ensure metal closures are free of sharp edges and burrs.

.5 Report unsatisfactory conditions to the Engineer in writing.

.6 Do not start work until deficiencies have been corrected. Commencement of Work implies acceptance of conditions.

3.3 PREPARATION

.1 Prepare and clean substrate surfaces in accordance with manufacturer's printed instructions.

3.4 INSTALLATION

.1 Coordinate installation with Section 05 41 00 – Structural Metal Stud Framing.

.2 Install air/vapour barrier to interior side of walls as detailed.

.3 All membranes must overlap minimum 50 mm.

.4 Install minimum 150 mm wide strips of flexible membrane at base of wall liner, on all corner joints of interior metal liner at exterior wall, penetrations in exterior wall and roof and as indicated to form a continuous barrier.

.5 All penetrations, unless clearly indicated on Drawings and so installed shall be reviewed by Engineer.

.6 Inspect joint strips for continuity. Repair punctures and tears before work is concealed.

.7 Detail work:

.1 Cut membrane to fit around penetrations and apply bead of sealant to seal voids which may have been caused by fitting of membrane.

.2 To membrane into door frame interface sheet, to maintain continuity of air/vapour retader. Position lap seal over firm bearing.

.3 Coordinate installation of wall air/vapour retarder with roof vapour retarder to maintain continuity.

3.5 ELECTRICAL AND MECHANICAL PENETRATIONS

.1 Where electrical and mechanical elements penetrate the vapour barrier, seal flexible membrane to liner panel and lap to electrical or mechanical element.

.2 Provide effective seals within conduit between the inside and outside at the penetration.

3.6 INSPECTION

.1 Inspect entire installation and repair or replace damaged materials upon completion. Do not cover up any area or job mock-up until Engineer has reviewed installation of air/vapour barriers. Provide Engineer with five days notice to arrange review of the air/vapour barrier installations.

3.7 AIR/VAPOUR BARRIER

.1 Ensure all roof penetrations are in place before air/vapour barrier is applied.

.2 Touch up pre-primed sheathing in accordance with manufacturer's directions to solid black colour.

.3 Over primed deck install torch on air/vapour barrier membrane.

.4 Installed vapour barrier shall be torched on to form a complete and continuous membrane over the roof and wall connection, sealed at all joints and penetrations. Seal all roof penetrations with double layer of membrane.

.5 Sequence wall and roof air/vapour barrier installation as indicated to ensure positive air seal at junctions.

.6 Apply air/vapour barrier material to roof slope. Make laps so that flow of water over them and never against them. Reinforce peaks in roof to membrane manufacturer's recommendations. At wall/roof junction lap and seal polyethylene sheet vapour barrier with torch on roof vapour to ensuring continuous seal.

3.8 WEATHER BARRIER ROOF

.1 Install roof insulation in two layers.

.2 Install first level of insulation shiplapped edged, running with roof slope and adhere with insulation base layer fasteners and/or SBS modified mastic sufficient to secure until subsequent layers of insulation and Z-girts are installed. Fill all voids with spray foam insulation.

.3 Install Z-girts screw fastened at 600 mm o.c. through to steel deck, perpendicular to roof slope.

.4 Remove any fasteners which penetrate exposed steel deck.

.5 Install second layer of butt edged insulation butting boards tight to Z-girts and to each other so that no gaps or voids exist. Fill all voids with spray foam insulation.

.6 Over roof insulation, install weather barrier. Use tape as recommended by weather barrier manufacture to seal joints.

.7 Over weather barrier install sheet metal roofing.

.8 Use only tradesmen experienced in the work.

3.9 COMPLETION OF DAY'S WORK

.1 Apply bead of sealant along top edge of membrane to prevent water from seeping behind membrane.

.2 Tool sealant to ensure proper bond with substrate.

3.10 MEMBRANE INSPECTION AND REPAIR

.1 Have membrane manufacturer's technical representative inspect membrane upon completion.

.2 Correct damaged and defective areas immediately.

.3 Repair misaligned or inadequately lapped seams, punctures and other damage using a patch of membrane extending 100 mm in all directions from the edge of the damaged area. Seal edges of patch with mastic.

.4 Slit fishmouths and overlap flaps. Roll flaps to ensure proper contact and install patch over area.

3.11 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 07 19 00 – Air/Vapour Barriers

.2 Section 07 46 50 – Preformed Cladding/Siding System

.3 Section 07 61 00 – Sheet Metal Roofing

1.2 SCOPE OF WORK

.1 Supply and installation of all rigid insulation for the exterior on grade locations, the walls, the roof and the underside of structure as indicated in these contract documents. Supplement with wooden components as specified.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM International)

.1 ASTM C591-16, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

.2 ASTM C1126-15, Standard Specification for Faced or Unfaced Rigid Cellular phenolic Thermal Insulation.

.3 ASTM C1289-16, Standard Specification for Faced Rigid Cellular Polyisoocyanurate Thermal Insulation Board.

.4 ASTM E96/E96M-16, Test Methods for Water Vapour Transmission of Materials.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 71-GP-24M-77, Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S604-2016, Standard for Factory-Built Type A Chimneys.

.2 CAN/ULC-S701-11, Thermal Insulation, Polystyrene Boards and Pipe Coverings.

.3 CAN/ULC-S702-14, Standard for Thermal Insulation Mineral Fibre for Buildings.

Part 2 Products

2.1 INSULATION

.1 Rigid closed cell polystyrene for foundation application: to CAN/ULC-S701.1, type 4, compressive strength at 5% deformation 275 kPa, thermal resistance of 0.88 RSI/25 mm, thicknesses as specified, square shiplapped edges. Acceptable material: Dow Chemical Canada Styrofoam HI-40 or approved equal.

.2 Rigid closed cell polystyrene for roof application: to CAN/ULC-S701.1, type 4, thicknesses as specified, square shiplapped edges. Acceptable material: Dow Chemical Canada Styrofoam SM or approved equal.

.3 Rigid closed cell polystyrene for exterior wall application: to CAN/ULC-S701.1, type 4, thicknesses as specified, square shiplapped edges. Acceptable material: Dow Chemical Canada Styrofoam SM or approved equal.

2.2 ADHESIVE

.1 Adhesive (for polystyrene): to CGSB 71-GP-24, Type A, low VOC.

2.3 ACCESSORIES

.1 Insulation fastener clips: length to suit insulation thickness, impale type, perforated 50 x 50 cold rolled carbon steel 1.3 mm thick minimum, adhesive back, spindle of 2.5 mm diameter minimum annealed steel, 25 mm diameter minimum washers of self locking type and to meet insulation manufacturer's recommendations including spacing requirements.

.2 Fasteners: of same material as sheet steel metal and according to manufacturers standard system, suitable for application.

.3 Touch-up paint: as recommended by sheet metal roofing manufacturer.

2.4 WOOD MATERIALS

.1 Plywood or OSB Sheathing: unsanded exterior grade thicknesses as specified to CSA O121, CSA O151, or CSA O437.

.2 Nailers: dimensional S-P-F lumber (no PWF)

2.5 POLYETHYLENE SHEETING

.1 Polyethylene sheeting: 6 mil minimum thickness.

.2 Joint sealing tape: cloth duct tape.

.3 Joint sealant: compatible with poly sheeting, water resistant, minimum 50% elongation capabilities.

Part 3 Execution

3.1 MANUFACTURERS INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 WORKMANSHIP

.1 Install insulation to thickness as shown on drawings after substrate materials are dry.

.2 Install insulation to maintain continuity of thermal protection to elements and spaces.

.3 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Where two or more layers are required, offset joints from one layer to the next. Use only

insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.4 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.

.5 Offset both vertical and horizontal joints in multiple layer applications.

.6 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN4-S604 type A chimneys.

.7 Do not enclose insulation until it has been inspected and approved by Engineer.

3.3 EXAMINATION

.1 Examine substrates and immediately inform Engineer in writing of defects.

.2 Prior to commencement of work ensure:

.1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.4 RIGID INSULATION INSTALLATION

.1 Cut and trim insulation neatly to fit spaces. Butt all joints tightly offset vertical joints.

.2 Fasten 100 mm layer of insulation direct to concrete with Hilti fasteners at 400 mm o.c. max and at 400 mm o.c. max at free edges of all panels, install fasteners to manufacturer’s specifications.

.3 The second layer of insulation, where required, shall be glued to the first layer. Apply the adhesive to polystyrene insulation board at rate in accordance with manufacturer's recommendations.

.4 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150 mm wide 0.15 mm polyethylene strip over expansion and control joints using compatible adhesive before application of insulation.

.5 At perimeter wall locations seal and tape poly tight against concrete surfaces to maintain integrity of poly sheet layer.

.6 Butt insulation panels tight to adjacent panels except where specifically indicated otherwise. Cut insulation neatly to fit tightly around columns, pipe supports and other interruptions.

.7 Under Slab Application: Extend boards from perimeter of foundation as indicated. Lay boards on level compacted fill. The second layer of insulation, where required, shall be pinned per manufacturer’s requirements and the joints staggered.

3.5 ROOF INSTALLATION

.1 On roof locations, mechanical fasteners may be used that fasten both the densedeck sheathing and the rigid insulation simultaneously. Submit proposal to Engineer for approval if this approach is adopted.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

.2 Section 07 21 20 – Rigid Insulation

.3 Section 07 62 00 – Sheet Metal Flashing and Trim

.4 Section 07 92 10 – Joint Sealants

.5 Section 09 91 23 – Painting

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI B18.6.5M-2000, Metric Thread Forming and Thread Cutting Tapping Screws.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc, Coated (Galvanized) or Zinc-Iron Alloy – Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM D1005-95(2013) Standard Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers.

.3 ASTM F1667-17, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

.3 Canadian Sheet Steel Building Institute (CSSBI)

.1 Bulletin No. 5 (latest edition).

.4 Canadian Standards Association (CSA)

.1 CSA S136-16, North American Specification for the Design of Cold-Formed Steel Structural Members.

1.3 DESIGN CRITERIA

.1 Design exterior wall metal panel system in accordance with CSA S136.

.2 Allow for thermal movement of component materials caused by ambient temperature range of 80° C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.

.3 Design members to withstand dead load and wind loads calculated in accordance with structural design criteria indicated on drawings.

.4 Maximum allowable deflection of 1/180th of span.

1.4 SUBMITTALS

.1 Product data: submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 – Submittal Procedures.

.1 Submit copy of WHMIS MSDS – Material Safety Data Sheets in accordance with Section 01 33 00 – Submittal Procedures. Indicate VOC's for caulking materials during application and curing.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with 01 33 00 – Submittal Procedures.

.2 Indicate compliance with design criteria.

.3 Clearly indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, wall openings and penetrations required, head, jamb, sill and mullion details, flashings, metal furring, fascia and related work.

.4 Shop drawings shall be stamped by a professional engineer registered or licensed in the Territory of Nunavut, Canada.

.3 Samples:

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

.2 Samples shall be representative of exterior siding material, finish, colour and profile specified including sealant and exposed fasteners.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation and maintenance instructions.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Handle and store siding to prevent stressing of panels. Warping, twisting or bending of panels may lead to oil-canning of finished product.

.2 Stack panel sheets tilted to provide water run-off.

.3 Cover components to protect from direct moisture penetration. Vent to encourage air movement.

Part 2 Products

2.1 STEEL CLADDING AND COMPONENTS

.1 Sheet Steel: to ASTM A653/A653M, Grade 230, galvanized, Z275 coating designation, factory pre-coated with paint finish as specified below.

.1 Finish coating: silicone modified polyester.

.2 Colour: as selected later from manufacturer's standard range of colours.

.3 Gloss: medium.

.4 Minimum thickness: 0.61 mm base metal thickness.

.5 Profile: Vertical ribbed, preformed interlocking joints, fastener holes pre-punched, based on Vic West CL725.

.2 Fascia facings and exposed trim:

.1 Finish coating: silicon modified polyester

.2 Colour: as indicated on the drawings.

.3 Thickness: 0.61 mm base metal thickness.

.4 Gloss: medium.

.5 Profile: indicated.

.3 Interior metal liner:

.1 Fabricated from prefinished galvanized steel sheet.

.2 Profile: minimal depth, v-rib, interlocking joint profile

.4 Exterior and Interior Corners: of same material and finish as adjacent siding material, shop cut and brake formed to right angle with fastener holes pre-punched.

.5 Accessories: cap flashings, drip flashings, internal corner flashings, copings and closures for head, jamb, sill and corners, of same material and finish as exterior siding, brake formed to shape.

.6 Girts: of 1.2 mm minimum thickness, galvanized to ASTM A525M, Z275 coating designation, complete with structural fasteners to building walls.

.7 Screws: to ASTM B18.6.4 cadmium plated steel purpose made, head colour same as exterior sheet, dished steel/neoprene.

.8 Sealant: one component acrylic, colour to match siding.

.9 Gaskets: soft pliable vinyl, extruded profile, to achieve weather tightness when installed.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSTALLATION

.1 Install cladding in accordance with manufacturer's written instructions and reviewed shop drawings.

.2 Install continuous starter strips, inside and outside corners, edgings, soffit, drip, cap, sill and window/door opening flashings as indicated.

.3 Install outside corners, fillers and closure strips with carefully formed and profiled work.

.4 Install and fascia cladding as indicated.

.5 Install flashing and trim as required for complete, watertight enclosure.

.6 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.

.7 Cut necessary openings for mechanical, electrical and other penetrations and openings. Make joints around penetrating items perfectly tight.

.8 Attach components in manner not restricting thermal movement.

.9 Do not overdrive fasteners, so as to limit amount of thermal movement or to physically deform panel at fastener location.

.10 Caulk junctions with adjoining work with sealant. Do work in accordance with Section 07 92 10 – Joint Sealants.

.11 At vertical profiles exterior siding provide notched and formed top closures, caulked and sealed to arrest weather penetration.

.12 Completed installation to be free from noise, rattles, wind whistles, or noise due to thermal movement.

.13 Touch up panels and supports at all minor abrasions with touch-up paint as recommended by panel manufacturer.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 05 21 00 – Steel Joist Framing

.2 Section 05 41 00 – Structural Metal Stud Framing

.3 Section 07 19 00 – Air/Vapour Barriers

.4 Section 07 21 20 – Rigid Insulation

.5 Section 07 46 50 – Preformed Metal Wall Cladding / Siding

.6 Section 07 62 00 – Sheet Metal Flashing and Trim

.7 Section 07 92 10 – Joint Sealants

1.2 SECTION INCLUDES

.1 Materials and installation for sheet metal roofing.

1.3 REFERENCES

.1 American Society for Testing and Materials International (ASTM International)

.1 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process.

.3 ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.

.3 Canadian Standards Association (CSA International)

.1 CSA S136-16, North American Specification for the Design of Cold-Formed Steel Structural Members.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 DESIGN CRITERIA

.1 Design exterior roof metal panel system in accordance with CSA S136.

.2 Allow for thermal movement of component materials caused by ambient temperature range of 80° C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.

.3 Design members to withstand dead load, snow load and wind loads calculated in accordance with structural design criteria indicated on drawings.

.4 Maximum allowable deflection of 1/240th of span.

.5 Coordinate design with Section 05 21 00 Steel Joist Framing and Section 05 41 00 Structural Metal Stud Framing.

1.5 SUBMITTALS

.1 Shop Drawings:

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

.2 Shop drawings shall be stamped by a Professional Engineer registered or licensed in the Territory of Nunavut, Canada.

.3 Clearly indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, wall openings and penetrations required, head, jamb, sill and mullion details, flashings, metal furring, fascia and related work.

.4 Indicate compliance with design criteria.

.2 Samples:

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

.2 Submit 300 x 300 mm samples of each sheet metal material.

.3 Submit manufacturer's installation and maintenance instructions.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Handle and store siding to prevent stressing of panels. Warping, twisting or bending of panels may lead to oil-canning of finished product.

.2 Stack panel sheets tilted to provide water run-off.

.3 Cover components to protect from direct moisture penetration. Vent to encourage air movement.

Part 2 Products

2.1 SHEET METAL MATERIALS

.1 Zinc coated steel sheet: to ASTM A653/A653M, commercial quality, Grade 340, Z275 coating, pre-finish as specified in 2.2.

2.2 PREFINISHED STEEL SHEET

.1 Prefinished steel with factory applied silicone modified polyester.

.1 Specular glass: 30 units +/-5 in accordance with ASTM523.

.2 Colour: as selected later from manufacturer's standard range of colours.

.3 Coating thickness: not less than 25 micrometers.

.4 Film hardness: F-2H in accordance with ASTM D3363.

.5 Colour change: to ASTM D2244

.1 Vertical: 30 years – dE 5 maximum

.2 Non-vertical: 30 years – dE 8 maximum.

.6 Chalking: to ASTM D4214 (Method A)

.1 Vertical: 30 years – No. 8 rating.

.2 Non-vertical: 30 years – No. 6 rating.

.7 Gloss: medium.

.8 Steel Sheet Thickness not less than 0.61 mm.

.9 Profile: Vicwest.

.2 Panel Widths as recommended by manufacturer.

2.3 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Closures: Foam and metal closures to suit profile selected and per manufacturer's recommendations.

.3 Sealant: refer to Section 07 92 10 - Joint Sealants and to manufacturer's recommendations.

.4 Fasteners: of same material as sheet steel metal and according to manufacturers standard system, suitable for sheet metal roofing application.

.5 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.6 Touch-up paint: as recommended by sheet metal roofing manufacturer.

.7 Roof pipe penetration boot flashing: 35 Year Master Flash by Aztec Washer Co. or approved equal.

.8 Insulation: to Section 07 21 20 – Rigid Insulation.

.9 Air/Vapour Barriers: to Section 07 19 00 – Air/Vapour Barriers.

2.4 FABRICATION

.1 Form individual pieces in continuous lengths. Make allowances for expansion at joints.

.2 Hem exposed edges on underside 12 mm, mitre and seal.

.3 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

Part 3 Execution

3.1 EXAMINATION

.1 Examine work of other sections upon which work of this section depends.

.2 Report any discrepancies to Engineer before beginning work on the roof system.

3.2 INSTALLATION

.1 Use concealed fastenings except where approved by Engineer before installation.

.2 Install liner panel/vapour barrier and sheet metal roof panels in accordance with reviewed shop drawings and manufacturer's written instructions.

.3 Flash roof penetrations with pipe boot flashing, and make watertight.

.4 Form seams in direction of water-flow and make watertight.

.5 Apply sheet metal roofing beginning at ridge and continuous in one piece to eave all in accordance with manufacturer's written instructions.

3.3 CLEAN-UP

.1 Remove protective film from panels.

.2 Clean exposed panel surfaces in accordance with manufacturer's written instructions.

.3 Repair and touch-up minor surface damage with colour matching high grade enamel only where permitted by Engineer and only where appearance after touch-up is acceptable to engineer.

.4 Replace damaged panels and components that, in the opinion of the Engineer, cannot be satisfactorily repaired.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 07 41 10 – Preformed Cladding / Siding System

.2 Section 07 92 10 – Sealants

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM International)

.1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM F1667-13, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

.2 Canadian Roofing Contractors Association (CRCA)

.1 Roofing Specifications Manual latest edition.

.3 Canadian Sheet Steel Building Institute (CSSBI)

.1 CSSBI Bulletin #5 latest edition.

1.3 WORK INCLUDED

.1 Supply and install all metal flashing, metal trim, rainwater troughs and other rainwater goods as specified in the contract documents.

1.4 QUALIFICATIONS

.1 Only competent and qualified tradesmen shall execute the work of this section.

1.5 SHOP DRAWINGS AND SAMPLES

.1 Submit details for all systems for review prior to fabrication.

.2 Provide samples upon request.

Part 2 Products

2.1 SHEET METAL MATERIALS

.1 Zinc coated steel sheet: 0.70 mm (24 gauge) thickness unless noted otherwise, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating; and in accordance with CSSBI Bulletin #5.

2.2 PREFINISHED STEEL SHEET

.1 Prefinished steel with factory applied silicone modified polyester.

.1 Colour from standard 10000 series; colour of all metal flashing, trim and rainwater goods to be uniform and to match preformed metal siding colour.

.2 Coating thickness: not less than 25 micrometres.

2.3 ACCESSORIES

.1 Plastic cement: to CAN/CGSB-37.5-M89.

.2 Sheet metal screws: cadmium plated, self-tapping.

.3 Sealants: in accordance with Section 07 92 10, colour to match metal trim.

.4 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet steel being secured. *Flashing anchor clips: 0.85 mm + 0.1 mm galvanized steel.*

.5 Fasteners: of same material as sheet metal, to ASTM F1667, ring thread flat head roofing nails of length and thickness suitable for metal flashing application. *Flashing nails: #12 hot dipped zinc coated, annular ringed.*

.6 Washers: of same material as sheet metal, 1 mm thickness with rubber packings.

.7 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series specifications and as detailed and approved.

.2 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints. Maintain minimum 25 mm lap at all joints.

.3 Hem exposed edges on underside 12 mm. Mitre and seal corners with sealant.

.4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

.1 Form flashings, copings and fascias to profiles indicated of 0.55 mm thick prefinished steel metal.

Part 3 Execution

3.1 INSTALLATION

.1 Install sheet metal work in accordance with industry standard practices.

.2 Use concealed fastenings except where approved before installation.

.3 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.

.4 Lock flashing end joints and ensure that one end of each section is free to move at the joint.

.5 Caulk all joints with sealant.

.6 Caulk flashing at cap flashing with sealant.

.7 Install pans, where shown around items projecting through roof membrane.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Fire stopping and smoke seals within mechanical assemblies (i.e. inside ducts, dampers) and electrical assemblies (i.e. inside cable trays) are specified in Division 15 and 16 respectively.

1.2 REFERENCES

.1 National Building Code of Canada (NBCC) 2015

.2 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S115-11, Standard Method of Fire-Tests of Firestop Systems.

1.3 SUBMITTALS

.1 Samples:

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

.2 Submit duplicate 300 x 300 mm sample, as applicable of each type of firestopping.

.2 Shop Drawing:

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

.2 Submit shop drawings to show proposed material, fire rating, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.

.3 Product Data:

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

.2 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.

Part 2 Products

2.1 MATERIALS - GENERAL

.1 Fire stopping and smoke seal systems: in accordance with ULC-S115.

.1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ULC-S115 and not to exceed opening sizes for which they are intended.

.2 Where more than one product is acceptable for a component, clearly indicate the product being supplied on this project.

.2 Service penetration assemblies: certified by ULC in accordance with ULC-S115 and listed in ULC Guide No.40 U19.

.3 Service penetration firestop components: certified by ULC in accordance with CAN/ULC-S115 and listed in ULC Guide No.40 U19.13 and ULC Guide No.40 U19.15 under the Label Service of ULC.

2.2 FIRESTOPPING / SMOKE SEAL MATERIALS

.1 Mineral wool: ULC listed, semi-rigid, non-combustible, capable of being compressed 75% of original width; precut to required width and depth required, complete with impaling clips for use in horizontal fire separations; product as recommended by Firestopping manufacturer and listed in applicable ULC design.

.2 Firestopping sealant: ULC listed.

.1 Silicone: one-part silicone based, non-sag or self-levelling for floor; movement capabilities minimum 25%.

.1 Standard of acceptance: Firebarrier Silicone/Silicone SL by A/D Fire Protection System, CP604/601S by Hilti, Fire Barrier Silicone Sealants by 3M Fire Protection Products, TREMstop Fyre-Sil by Tremco.

.2 Acrylic: one-part, water-based, flexible to accommodate movement.

.1 Standard of acceptance: Firebarrier Seal by A/D Fire Protection System, CP606 by Hilti, Fire Barrier water-based sealants by 3M Fire Protection Products, TREMstop Acrylic by Tremco.

.3 Miscellaneous firestopping products:

.1 Other products, such as mortar, fire blocks, collars, putty, intumescent sealants and foams, may be used provided such products are ULC listed.

.2 At combustible piping, in addition to firestopping sealant, provide intumescent tape and retaining collar.

.4 Fire-resistance rating of installed fire stopping assembly in accordance with NBCC.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.10 Sealants for vertical joints: non-sagging.

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 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.

.2 Use cable management sleeve where communication cables (data, phone, radio) pass through fire and smoke separations.

.3 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.4 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.5 Tool or trowel exposed surfaces to a neat finish.

.6 Remove excess compound promptly as work progresses and upon completion.

3.4 INSPECTION

.1 Notify Engineer when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.5 SCHEDULE

.1 Firestop and smoke seal at:

.1 Penetrations through fire-resistance rated gypsum board partitions and walls.

.2 Top of fire-resistance gypsum board partitions.

.3 Openings and sleeves installed for future use through fire separations.

.4 Around mechanical and electrical assemblies penetrating fire separations.

.5 Rigid ducts: greater than 129 cm^2: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.6 CLEAN UP

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application.

.2 Trim excess cured foam, if necessary, with a sharp knife or blade.

.3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 07 62 00 – Sheet Metal Flashing and Trim

.2 Section 08 11 00 - Steel Doors and Frames

1.2 WORK INCLUDED

.1 Materials, preparation and application for sealants. Supply and install all sealants as per the contract documents excluding:

.1 Concrete sealants as per Section 03 30 00.

.2 Preformed Metal Siding / Cladding Systems Sealants as per Section 07 46 50.

1.3 REFERENCES

.1 ASTM International (ASTM).

.1 ASTM C920-14a, Specification for Elastomeric Joint Sealants.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).

.2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.3 CAN/CGSB-19.17-M90, One Component Acrylic Emulsion Base Sealing Compound.

.4 CAN/CGSB-19.18-M87, Sealing Compound, One Component, Silicone Base, Solvent Curing.

.5 CAN/CGSB-19.21-M87, Sealing and Bedding Compound Acoustical.

.6 CAN/CGSB-19.24-90, Multi-component, Chemical Curing Sealing Compound.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

.1 Submit product data, samples and manufacturer’s instructions in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Manufacturer's product to describe:

.1 Caulking compound.

.2 Primers.

.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Samples:

.1 Submit duplicate samples of each type of material and colour.

.2 Cured samples of exposed sealants for each color where required to match adjacent material.

.3 Manufacturer’s Instructions:

.1 Instructions to include installation instructions for each product used.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, handle, store and protect materials in accordance with manufacturer’s recommendations.

.2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

1.6 PROJECT CONDITIONS

.1 Environmental Limitations:

.1 Do not proceed with installation of joint sealants under following conditions:

.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 5 °C.

.2 When joint substrates are wet.

.3 Should it become necessary to apply sealants below 5 °C, consult sealant manufacturer and follow their recommendations.

.2 Joint-Width Conditions:

.1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:

.1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labeling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.

.2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

1.8 WARRANTY

.1 Sealant which, within one year of Final Completion, exhibits dust and dirt collection and which is soft or tacky to the touch shall be replaced to the satisfaction of the Engineer at no additional cost to the Owner.

.2 Sealant which, within 3 years of Final Completion, leaks, cracks, crumbles, melts shrinks, runs, looses adhesion or stains adjacent surfaces shall be replaced at no cost to the Owner.

Part 2 Products

2.1 SEALANT MATERIAL DESIGNATIONS

.1 Sealants acceptable for use on this project shall be listed on CGSB Qualified Products list issued by CGSB Qualification Board for Joint Sealants. Where sealants are qualified with primers use only these primers.

.2 Urethanes Two Part.

.1 Non-Sag to CAN/CGSB-19.24, Type II, Class B.

.2 Acceptable material: Tremco Dymeric 240 or approved equal.

.3 Colour of sealant: to closely match surface being sealed.

.3 Acrylic Latex One Part.

.1 Non-sag, mildew resistant, paintable to CAN/CGSB-19-GP-17M.

.2 Acceptable material: Tremco Tremflex 834 Siliconized Acrylic Latex or approved equal.

.4 Preformed Compressible and Non-Compressible back-up materials.

.1 Polyethylene, Urethane, Neoprene or Vinyl Foam.

.1 Extruded closed cell foam backer rod.

.2 Size: oversize 30 to 50 %.

.2 Neoprene or Butyl Rubber.

.1 Round solid rod, Shore A hardness 70.

.3 High Density Foam.

.1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m^3 density, or neoprene foam backer, size as recommended by manufacturer.

.4 Bond Breaker Tape.

.1 Polyethylene bond breaker tape which will not bond to sealant.

.5 Accessories: back-up rod, etc., as required to complete the work.

.6 Joint cleaner: xylol, methylethyleketone (MEK) or noncorrosive type recommended by sealant manufacturer and compatible with joint-forming materials.

.7 Primers: type recommended by sealant manufacturer.

2.2 SEALANT SCHEDULE

.1 Acrylic Sealant:

.1 Between pressed steel interior door frames and adjacent finishes.

.2 Perimeters of exterior wall penetrations on interior side.

.2 Urethane two part sealant:

.1 Perimeter of exterior pressed steel frames and wall penetrations.

2.3 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer. Primer: as recommended by manufacturer.

Part 3 Execution

3.1 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

.1 Sealant:

.1 Apply sealants in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, and embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.2 Cure sealants in accordance with sealant manufacturer's instructions. Do not cover up sealants until proper curing has taken place.

.3 Clean adjacent surfaces immediately and leave Work neat and clean. Remove excess and droppings, using recommended cleaners as work progresses. Remove masking tape after initial set of sealant.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 07 92 10 – Joint Sealants: Caulking of joints between frames and other building components.

.2 Section 08 71 00 – Door Hardware: Supply of finish hardware, including weatherstripping and mounting heights.

.3 Section 08 80 50 – Glazing.

.4 Section 09 91 23 – Painting.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A123/A123M-15, Standard Specification for Zinc Hot Dip Galvanized Coatings on Iron and Steel Products.

.2 ASTM A653/A653M-15e1, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Canadian Standards Association (CSA International)

.1 CSA A440-00/A440.1-00(R2005), Windows / Special Publication A440.1-00, User Selection Guide to CSA Standard CAN/CSA-A440.00, Windows.

.2 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.

.3 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

.3 Canadian Steel Door Manufacturers' Association (CSDMA)

.1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2009.

.2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 2009.

.4 National Fire Protection Association (NFPA)

.1 NFPA 80-2013, Standard for Fire Doors and Other Opening Protectives.

.2 NFPA 252-2012, Standard Methods of Fire Tests of Door Assemblies.

.5 Society for Protective Coatings (SSPC)

.1 Systems and Specifications Manual, SSPC Painting Manual, Volume Two.

.6 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S104-10, Standard Method for Fire Tests of Door Assemblies.

.2 CAN/ULC-S105-16, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.

.3 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.4 CAN/ULC-S702-14, Standard for Thermal Insulation, Mineral Fibre, for Buildings.

.5 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -45 degrees C to 35 degrees C.

.2 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC-S104 and NFPA 252 for ratings specified or indicated.

.3 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC-S104, and listed by nationally recognized agency having factory inspection services.

1.4 SUBMITTALS

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

.2 Provide product data:

.1 Submit manufacturer’s printed literature, specifications and data sheet. Procedures.

.3 Provide shop drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Territory of Nunavut, Canada.

.2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, arrangement of hardware, and finishes.

.3 Indicate each type door frame material, core thickness, reinforcements, location of anchors and exposed fastenings, reinforcing, and finishes.

.4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

.5 Submit installation instructions.

1.5 REQUIREMENTS

.1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC-S104M or NFPA for ratings specified as indicted.

1.6 QUALITY ASSURANCE

.1 Doors and frames which exhibit rusting or distortion and/or surface irregularities due to improper fabrication or handling shall be rejected.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's requirements.

.2 Store and protect windows from nicks, scratches, and blemishes.

Part 2 Products

2.1 MATERIALS

.1 Steel doors and frames: commercial quality. Standard of acceptance: products by current CSDMA member.

.2 Hot dipped galvanized steel sheet: to ASTM A653M, ZF275 (G90), minimum base steel thickness 1.5 mm (16 gauge) in accordance with CSDMA Table 1 - Thickness for Component Parts.

.3 Reinforcement: to CSA G40.20/G40.21, Type 300W, coating designation to ASTM A653M, ZF275.

2.2 DOOR CORE MATERIALS

.1 Stiffened: face sheets honeycomb insulated core.

.1 Polyurethane: to CAN/ULC-S704 rigid, modified poly/isocyanurate, closed cell board. Density 32 kg/m^3.

.2 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door to 250 degrees C at 60 minutes. Core to be tested as part of a complete door assembly, in accordance with CAN/ULC-S104 or NFPA 252 covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

2.3 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.2 Polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

.3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesives.

2.4 PRIMER

.1 Rust inhibitor touch-up prime.

2.5 PAINT

.1 Field paint steel doors and frames in accordance with Section 09 91 23 - Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

2.6 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.

.2 Exterior and interior top and bottom caps: rigid polyvinylchloride extrusion.

.3 Metallic paste filler: to manufacturer's standard.

.4 Fire labels: metal riveted.

.5 Sealant: See Section 07 92 10 – Joint Sealants.

.6 Frame floor anchors and channel spreaders: minimum 1.6 mm (0.06”) thick base steel.

.7 Guard boxes: minimum 0.8 mm (0.03”) thick base sheet.

.8 Corrugated steel Frame tee anchors: thickness and design approved by ULC.

.9 Hinge, strike, butt and closer, reinforcing: minimum 3.5 mm thick base steel.

.10 Door bumpers: black neoprene.

.11 Reinforcing channel: to CSA G40.21, 300W grade.

.12 Thermal break: extruded PVC.

2.7 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated.

.3 Exterior frames: 2 mm (14 gauge) insulated welded type construction c/w spray polyurethane insulation infill. Exterior frames to be thermally broken.

.4 Interior frames: 2 mm (14 gauge) welded type construction.

.5 Blank, reinforce, drill and tap frames for mortised, and templated hardware, using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.6 Protect strike and hinge reinforcements using steel guard boxes welded to frames.

.7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.

.8 Manufacturer's nameplates on frames are not permitted.

.9 Conceal fastenings except where exposed fastenings are indicated.

.10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

.11 Insulate exterior frame components with low expansion spray polyurethane insulation.

2.8 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

.4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.9 FRAMES: WELDED TYPE

.1 Welding in accordance with CSA W59.

.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

.5 Securely attach floor anchors to inside of each jamb profile.

.6 Weld in two temporary jamb spreaders per frame to maintain proper alignment during shipment.

.7 Provide foam filler behind drillers and tappings of hollow metal frames to allow proper installation of hardware on site.

.8 Place minimum of three single bumpers on door frames; space equally along strike jambs for each single door.

2.10 DOOR FABRICATION GENERAL

.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

.2 Exterior doors: insulated with polyurethane core.

.3 Interior doors: as indicated on drawings. Hollow metal doors with welded steel stiffened construction.

.4 Fabricate steel doors in accordance with CSDMA, except where otherwise specified. Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

.5 Blank, reinforce, drill doors and tap for mortised and templated hardware.

.6 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.7 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

.8 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.9 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC-S104 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers. Door and frame shall be complete with required ULC listing and label affixed to the door and frame.

.10 Manufacturer's nameplates on doors are not permitted.

2.11 HOLLOW STEEL CONSTRUCTION

.1 Form each face sheet for interior doors from minimum 1.5 mm (16 gauge) sheet steel.

.2 Form each face sheet for exterior doors from minimum 1.5 mm (16 gauge) sheet steel.

.3 Reinforce doors with 20 gauge minimum vertical stiffeners, securely welded to face sheets at 150 mm on centre maximum.

.4 Fill voids between stiffeners of exterior doors with polyurethane core.

.5 Fill voids between stiffeners of interior doors with core construction as required by door standards.

2.12 THERMALLY BROKEN DOORS AND FRAMES

.1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.

.2 Thermal break: rigid polyvinylchloride extrusion.

.3 Fabricate thermally broken frames separating exterior parts form interior parts with continuous interlocking thermal break.

.4 Apply insulation in frame.

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 GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.2 Install doors and frames to CSDMA Installation Guide.

.3 Install viewing window in accordance with CSA A440/A440.1.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation. Remove welded metal spreaders on frames prior to setting in place.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Tie air barrier and vapour barrier into frame, continuity of air barrier and vapour barrier to be maintained.

.6 Insulate door frame with low expansion spray polyurethane insulation full width of frame.

.7 Caulk perimeter of frames between frame and adjacent material.

3.4 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

- .1 Hinge side: 1.0 mm.
- .2 Latchside and head: 1.5 mm.
- .3 Finished floor and thresholds: 13 mm.

.3 Adjust operable parts for correct function.

3.5 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 PAINTING

.1 Apply one coat spot priming, one coat enamel undercoat, two coats enamel to all exposed metal door and door frame surfaces in accordance with SSPC Painting Manual. All coats with product supplied by a single manufacturer.

.2 Sand and dust between each coat.

.3 Apply paint at air temperature recommended by the paint manufacturer.

.4 Finish shall be free of scratches or other blemishes.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by window installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 08 11 00 – Metal Doors and Frames.

1.2 REFERENCES

.1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)

.1 ANSI/BHMA A156.1-2016, Butts and Hinges.

.2 ANSI/BHMA A156.2-2011, Bored and Preassembled Locks and Latches.

.3 ANSI/BHMA A156.3-2014, Exit Devices.

.4 ANSI/BHMA A156.4-2013, Door Controls - Closers.

.5 ANSI/BHMA A156.5-2014, Auxiliary Locks and Associated Products.

.6 ANSI/BHMA A156.6-2015, Architectural Door Trim.

.7 ANSI/BHMA A156.8-2015, Door Controls - Overhead Stops and Holders.

.8 ANSI/BHMA A156.13-2012, Mortise Locks and Latches Series 1000.

.9 ANSI/BHMA A156.16-2013, Auxiliary Hardware.

.10 ANSI/BHMA A156.21-2014, Thresholds.

.11 ANSI/BHMA A156.22-2012, Door Gasketing and Edge Systems.

.2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)

.1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

.1 Use ULC Listed and labelled hardware for doors.

1.4 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 door hardware and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Hardware List:

.1 Submit contract hardware list.

.2 Indicate specified hardware including make, model, material, function, size, finish and other pertinent information.

.4 Manufacturer's Instructions: submit manufacturer's installation instructions.

.5 Closeout Submittals:

.1 Operation and Maintenance Data: submit operation and maintenance data for door closers and locksets for incorporation into manual.

1.5 MAINTENANCE MATERIALS SUBMITTALS

.1 Extra Stock Materials:

.1 Tools: Supply 2 sets of wrenches for door closers, locksets and fire exit hardware.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.4 Storage and Handling Requirements:

.1 Store materials in locked, clean, dry, and well-ventilated area.

Part 2 Products

2.1 HARDWARE ITEMS

.1 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

.1 Locks and latches:

.1 Mortise locks and latches: to ANSI/BHMA A156.13, designed for function as stated in schedule, having latch throw of 19 mm and dead bolt throw of 25 mm; lever handle trim. Function, finish and special features as listed in Hardware Schedule. Lever handles.

.1 Manufacturer: lock as manufactured by Best Access Control. No substitutions permitted.

.2 Normal strikes: box type, lip projection not beyond jamb ASA dimensions.

.3 Cylinders: to ANSI/BHMA A156.5, same finish as locksets.

.2 Butts and hinges: to ANSI/BHMA A156.1, full mortise, ball bearing, 5-knuckle; sizes listed in Hardware Schedule. Non-removable pins (NRP) for exterior doors.

.1 Standard weight, steel: Code A8112.

.1 Standard of acceptance: BB1279 by Hager, TA2714 by McKinney, FBB179 by Stanley.

.2 Heavy weight, brass or bronze: Code A2111.

.1 Standard of acceptance: BB1199 by Hager, T4A3386 by McKinney, FBB199 by Stanley.

.3 Heavy weight, stainless steel: Code A5111.

.1 Standard of acceptance: BB1199 by Hager or approved equal.

.3 Exit Devices: to ANSI/BHMA A156.3, exiting function only. Standard of acceptance: Corbin 3700 series or approved equal.

.4 Door Closers and Accessories:

.1 Door closers and overhead holders to be compatible.

.2 Door controls (closers): to ANSI/BHMA A156.4, modern type, surface application, full cover. Closer to have aluminum or cast-iron case, regular arm, plastic covers, adjustable closing power and back checking action. Silver lacquer finish. Mounting, arms and brackets as listed in schedule.

.1 Aluminum case: C02041 with C02191 mounting plate. Standard of acceptance: 351-Series by Sargent.

.3 Door controls (overhead holders): to ANSI/BHMA A156.8, Type C12541, heavy duty, surface mounted, slide action, size to suit door width.

.1 Standard of Acceptance: 90S Series by Glynn-Johnson, 9-series by Rixson, Series 590S by Sargent.

.5 Architectural door trim: to ANSI/BHMA A156.6,

.1 Door protection plates: kick plate, 1.27 mm thick stainless steel, bevelled edges; width less 40 mm on push side of door x 254 high. Standard of acceptance: Hager.

.6 Flush bolts: to ANSI/BHMA A156.16, type L04081 or L04201, cast or extruded brass, fire-rated where required, 300 mm long rod, 19 mm backset, including mortised keeper. Standard of acceptance: F65 by Standard Metal.

.7 Astragal: adjustable, flat bar 45 mm x 4.7 mm cold rolled steel with pile weatherstripping and finished to match doors. Standard of acceptance: W-8P by K.N. Crowder.

.8 Thresholds: full width of door opening, extruded aluminum, mill finish, errated surface, with thermal break of rigid PVC. Standard of acceptance: CT-45 by K.N. Crowder, DS501TB by DraftSeal, 421S by Hager, 252X3AFG by Pemko. 125 to 133 mm rigid thermal barrier.

.9 Weatherstripping:

.1 Head and jamb seal:

.1 Heavy duty, extruded aluminum frame, U-shaped to allow for mounting of closers and overhead holders/stops, 45 mm wide x 7.9 mm thick with bulb seal; clear anodized finish, length equal to jambs and head. Standard of acceptance: W-20N by K.N. Crowder, DS118 by DraftSeal.

.2 Door bottom seal:

.1 Heavy duty extruded aluminum frame, 32 mm wide with 3 mm thick black solid neoprene; full width. Clear anodized finish unless noted otherwise.Standard of acceptance: W-13S by K.N. Crowder, DS138C-2 by DraftSeal, 315-Series by Pemko, #39 by Zero.

2.3 FASTENINGS

.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.3 Exposed fastening devices to match finish of hardware.

.4 Use fasteners compatible with material through which they pass.

2.4 KEYING

.1 Locksets and cylinders to be keyed into new master key stem as directed. Submit keying schedule for approval. Prepare detailed keying schedule in conjunction with Engineer.

.2 Supply keys in duplicate for every lock in this Contract.

.3 Supply 2 master keys for each master key or grand master key group.

.4 Stamp keying code numbers on keys and concealed location on cylinders.

.5 Supply construction cores.

.6 Keyways to be geographically exclusive, not dealer exclusive.

.7 Hand over permanent cores and keys to Engineer.

Part 3 Execution

3.1 INSTALLATION

.1 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.2 Supply manufacturers' instructions for proper installation of each hardware component.

.3 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).

.4 Set threshold in bed of sealant. Fit threshold neat around door frame and caulk.

3.2 ADJUSTING

.1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.

.2 Lubricate hardware, operating equipment and other moving parts.

.3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.

.3 Remove protective material from hardware items where present.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by door hardware installation.

3.5 SCHEDULE

.1 Double Exterior Doors D100A and D100B: Emergency Generator Room Exterior 1830 x 2150 x 45 x IMD x PSF

.1 6 butts, NRP, 114 x 101 mm, heavy duty, brass or bronze.
.2 1 levered lockset.
.3 1 panic exit device.
.4 2 flush bolts (top and bottom cane bolts).
.5 2 closers (one each leaf).
.6 2 overhead stops.
.7 1 astragal.
.8 1 threshold; thermal break; weatherproof; length to suit.
.9 1 set weatherstripping.
.10 2 door bottom seals.

.2 Single Interior Door D100C: Emergency Generator Pump Room / Pump Room.

.1 3 hinges, 114 x 101 mm, standard weight, steel.
.2 1 passage set.
.3 1 kickplate 203 mm high 860 mm in length.
.4 1 closer.
.5 1 threshold; length to suit.

.3 Double Exterior Doors D101A and D101B: Pump Room Exterior 1830 x 2150 x 45 x IMD x PSF

.1 6 butts, NRP, 114 x 101 mm, heavy duty, brass or bronze.
.2 1 levered lockset.
.3 1 panic exit device.
.4 2 flush bolts (top and bottom cane bolts).
.5 2 closers (one each leaf).
.6 2 overhead stops.
.7 1 astragal.
.8 1 threshold; thermal break; weatherproof; length to suit.
.9 1 set weatherstripping.
.10 2 door bottom seals.

.4 Single Exterior Door D101C: Pump Room.

.1 3 butts, NRP 114 x 101 mm, heavy duty, brass or bronze.
.2 1 levered lockset.
.3 1 panic device.
.4 1 kickplate 203 mm high 860 mm in length.
.5 1 closer.
.6 1 overhead stop.
.7 1 threshold; thermal break; weatherproof; length to suit.
.8 1 set weatherstripping.
.9 1 door bottom seal.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

- .1 ASTM C475/C475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .2 ASTM C840-17, Standard Specification for Application and Finishing of Gypsum Board.
- .3 ASTM C919-12, Standard Practice for Use of Sealants in Acoustical Applications.
- .4 ASTM C1002-16, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .5 ASTM C1280-13a, Standard Specification for Application of Gypsum Sheathing Board.
- .6 ASTM C1396/C1396M-14a, Standard Specification for Gypsum Board.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- .2 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN/ULC S702-14, Standard for Mineral Fibre Thermal Insulation for Buildings.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.

.2 Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.

.3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

1.4 SITE ENVIRONMENTAL REQUIREMENTS

.1 Maintain temperature minimum 10 degrees C, maximum 21 degrees C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

.3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials as directed by Owner.

Part 2 Products

2.1 MATERIALS

.1 Impact-resistant gypsum board:

.1 Construction: fibre glass mesh scrim embedded within high-density layer of gypsum and cellulose fibres, light-weight core and high-density fibre-reinforced gypsum layer.

.2 Physical properties to meet ASTM C1396/C1396M.

.3 Fire rating: equivalent to Type X gypsum board when tested in accordance with CAN/ULC-S101.

2.2 ACCESSORIES

.1 Steel drill screws: to ASTM C1002, self drilling, self threading; of length to give minimum penetration of 16 mm into wood. Use corrosion resistant screws for cement board application.

.2 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, fill type, metal zinc-coated by electrolytic process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.3 Acoustical insulation: mineral fibre, to CAN/ULC-S702, ULC labelled; 40 kg/m^3 density containing minimum 35% recycled content

.4 Acoustic sealant: to ASTM C919.

.5 Polyethylene: to CAN/CGSB-51.34, Type 2.

.6 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.

.7 Joint compound: to ASTM C475, asbestos-free.

Part 3 Execution

3.1 ERECTION

.1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.

.2 Do application of gypsum sheathing in accordance with ASTM C1280.

.3 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.

3.2 APPLICATION

.1 Do not apply gypsum board until bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.

.2 Apply gypsum board to metal furring or framing using screw fasteners.

.1 Double-Layer Application:

.1 Fire-rated: In accordance with ULC design.

.3 Install gypsum board on walls vertically to avoid end-butt joints. At high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.4 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

.5 Install gypsum board with face side out.

.6 Do not install damaged or damp boards.

.7 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.3 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre using contact adhesive for full length.

.2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated.

.3 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.4 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.

.5 Provide continuous polyethylene dust barrier behind and across control joints.

.6 Locate control joints:

.1 At changes in substrate construction.

.2 At approximate 10 m spacing on walls.

.3 Where indicated.

.7 Install control joints straight and true.

.8 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.9 Embed tape for joints and interior angles in joint compound and apply two separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

.10 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.11 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.12 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.13 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

END OF SECTION

Part 1 General

1.1 DEFINITION

.1 The term “paint” as used herein means all generic types of paints, stains, varnishes and coatings including one-component and multiple-component systems.

1.2 REFERENCES

.1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 Master Painters Institute (MPI)

.1 MPI Architectural Painting Specifications Manual, 2004

.3 National Fire Code of Canada 2010 (NFCC).

.4 Society for Protective Coatings (SSPC)

.1 SSPC Painting Manual, Volume Two, Systems and Specifications Manual, latest edition.

1.3 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 20 - Health and Safety Requirements.

1.4 SUBMITTALS

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

.2 Product Data:

.1 Submit a complete list of products.

.2 Submit product data and instructions for each paint and coating product to be used in relation to finish formula and include the finish formula designation, product type and use, CGSB number, Manufacturer’s product number and colour numbers.

.3 Submit product data for the use and application of paint thinner.

.4 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.

.5 Submit materials in accordance with Section 01 77 00 – Closeout Submittals.

.3 Manufacturer's Instructions:

.1 Submit manufacturer's installation and application instructions.

.4 Samples:

.1 Submit full range colour sample chips to indicate where colour availability is restricted.

.2 Colours shall be selected by Owner.

1.5 MAINTENANCE

.1 Extra Materials:

.1 Deliver extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels.

.2 Quantity: provide one four litre can of each type and colour of primer, stain, finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

.3 Delivery, storage and protection: comply with Engineer requirements for delivery and storage of extra materials.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, Shipping, Handling and Unloading:

.1 Pack, ship, handle and unload materials in accordance with manufacturer's written instructions.

.2 Acceptance at Site:

.1 Identify products and materials with labels indicating:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and rejected materials from site.

.4 Storage and Protection:

.1 Provide and maintain dry, temperature controlled, secure storage.

.2 Store materials and supplies away from heat generating devices.

.3 Store materials and equipment in well ventilated area with temperature range 10 degrees C to 30 degrees C.

.5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.

.7 Remove paint materials from storage only in quantities required for same day use.

.8 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.9 Waste Management and Disposal:

.1 Place materials defined as hazardous or toxic in designated containers.

.2 Handle and dispose of hazardous materials in accordance with regulations.

.3 Ensure emptied containers are sealed and stored safely.

.4 Unused paint and coating materials must be disposed of at official hazardous material collections site as approved by Engineer.

.5 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.6 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.7 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.8 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

1.7 SITE CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Ventilate enclosed spaces.

.2 Provide temporary heating where permanent facilities are not available to maintain minimum recommended temperature before, during and after paint application until paint has cured sufficiently.

.3 Provide continuous ventilation for seven days after completion of application of paint.

.4 Coordinate use of existing ventilation system with Engineer and ensure its operation during and after application of paint as required.

.5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless pre-approved written approval by product manufacturer, perform no painting when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are not expected to fall within paint manufacturer's prescribed limits.

.4 Rain or snow is forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.5 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can withstand 'normal' adverse environmental factors.

.3 Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.4 Additional interior application requirements:

.1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

Part 2 Products

2.1 PAINT MATERIALS

.1 Paint materials: By MPI Architectural Painting Specification Manual Approved Products List (APL) PPG Protective and Marine Coatings or approved equal, unless specified otherwise.

.1 Products listed herein refer to the type and quality required for particular surface being finished.

.2 Paint: manufacturer’s “First Quality”, “Best Quality”, “Top Line”, “Professional Grade” or “Architectural Grade”.

.3 Low odour products: Whenever possible, select products exhibiting low odour characteristics. If two products are otherwise equivalent, select the product with the lowest odour.

.2 Linseed oil, shellac, and turpentine and thinners shall be pure, of high quality, compatible with other coating materials and bear the manufacturer’s label.

.3 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:

.1 Water-based, water soluble, water clean-up.

.2 Non-flammable.

2.2 COLOURS

.1 Selection of colours from manufacturer's full range of colours.

.2 Exterior bollards to be red. Steel door frames and doors to be confirmed. Structural steel framing and OWSJ's to be white. Where specific products are available in restricted range of colours, selection based on limited range.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.

.4 Thin paint for spraying in accordance with paint manufacturer's instructions.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 INTERIOR PAINTING SYSTEMS

.1 Steel man doors and door frames – polyurethane:

.1 Touch-up: To match existing primer.

.2 One Coat: Amershield or approved equal, 5.0 mil DFT.

.2 Gypsum board walls – epoxy acrylic:

.1 Primer: One coat Amercoat 335 or approved equal, 2-3 mil DFT.

.2 Top Coat: One coat Amercoat 335 or approved equal, 2-3 mil DFT.

.3 Structural steel and OWSJ's and miscellaneous fabrications (beams, columns, base plates) – polyurethane:

.1 Touch-up: To match existing primer.

.2 Two coats: Amershield or approved equal, 5.0 mil DFT per coat.

2.5 EXTERIOR PAINTING SYSTEMS

.1 Steel man-doors and frames - alkyd:

.1 Touch-up: Zinc-rich primer.

.2 Two Coats: Exterior-interior gloss enamel, 6-line.

.2 Exterior Wood Preservation:

.1 Cupinol or Pentox, clear sealer type, two coats.

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 data sheet.

3.2 GENERAL

.1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer’s written application instructions.

3.3 WORKMANSHIP

.1 Work shall be by skilled tradesmen working under the direction of a capable foreman and in accordance with manufacturer’s written instructions.

.2 Apply paint materials in a workmanlike manner with suitable equipment in clean condition and in accordance with paint manufacturer's written application instructions.

.3 Apply materials evenly, uniform in sheen, colour and texture, free from roller and brush marks, sags, crawls, runs or other defects detrimental to appearance or performance.

.4 Apply sufficient paint to produce a solid, uniform appearance satisfactory to the Engineer, regardless of the number of coats specified for any surface.

.5 Areas exhibiting incomplete or unsatisfactory coverage shall have entire plane repainted. Parching will not be acceptable.

3.4 EXAMINATION

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Engineer damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple “cover patch test”. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 Maximum moisture content as follows:

.1 Gypsum board: 12%.

.2 Concrete: 12%

3.5 PREPARATION

.1 Protection:

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Engineer.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.2 Surface Preparation:

.1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.

.2 Ensure surfaces are dry, clean and free from dust, dirt, tool or sandpaper marks, grease or other foreign matter.

.3 Prepare surfaces in accordance with manufacturer's written instructions.

3.6 APPLICATION

.1 Apply materials in strict accordance with manufacturer's application instructions.

.2 Brush paint trim work. Brush or roller paint other work. Use of spray equipment shall be at Owner's discretion.

.3 Thoroughly mix materials before application, and apply coats of paint evenly, free from sags, runs, crawls and other defects. Do cutting-in neatly.

.4 Only use thinning and tinting materials recommended by the manufacturer for the particular material being thinned or tinted.

.5 Apply coatings in a dust-free atmosphere with ambient temperatures not less than 10 degrees C. Controlled ventilation must be provided during application and drying.

.6 Do not undertake exterior painting at temperatures 10 degrees C or less, immediately following rain, frost, dew or when surfaces are damp or hot.

.7 Apply each coat of paint well, at proper consistency. Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer. Sand lightly with fine or very fine sandpaper between each coat.

3.7 MECHANICAL/ELECTRICAL EQUIPMENT

.1 Paint both sides and edges of backboards electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.8 SITE TOLERANCES

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.9 RESTORATION

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Engineer. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 National Fire Protection Association (NFPA)

.1 NFPA 10, Portable Fire Extinguishers. 2013 Edition.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets.

.3 Provide shop drawings.

.4 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual.

Part 2 Products

.1 Cartridge operated type with hose and shut-off nozzle, ULC labelled for A, B and C class protection.

.1 Size 4.5 kg.

2.2 EXTINGUISHER BRACKETS

.1 Provide brackets for each extinguisher to hang on wall. Type recommended by extinguisher manufacturer.

2.3 IDENTIFICATION

.1 Identify extinguishers in accordance with recommendations of ANSI/NFPA 10.

.2 Attach tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install or mount extinguishers on brackets in accordance with NFPA 10.

3.3 FIELD QUALITY CONTROL

.1 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.

END OF SECTION

Part 1 General

1.1 INTENT

.1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.

.2 Contract documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.3 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

.4 Install equipment generally in locations and routes shown. Run piping and ductwork close to building structure, parallel to building lines to maximize headroom and with minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Engineer at no extra cost.

.5 Install equipment to provide access and ease of maintenance.

.6 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test.

.7 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance. The Contractor shall, at his own expense, repair and replace any work which fails or becomes defective during the term of the guarantee/warranty, providing such work is not due to improper usage. The period of guarantee specified shall not in any way supplant any other guarantees of a longer period but shall be binding on work not otherwise covered. Coordinate with the requirements of Division 1.

.8 If the equipment is used during construction, the guarantee or guarantee period shall not be shortened or altered.

.9 'Provide' shall mean 'supply and install'.

1.2 TRIAL USAGE

.1 Engineer may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.3 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

.1 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.

.2 Where specified elsewhere in Division 23, manufacturers to provide demonstrations and instructions.

.3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Where deemed necessary, Engineer may record these demonstrations on video tape for future reference

1.4 COORDINATION OF WORK

.1 Cooperate and coordinate with other trades on the project.

.2 Make reference to electrical, mechanical, structural, civil and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

.3 Where dimensional details are required, work with the applicable architectural and structural drawings.

.4 Full-size and detailed drawings shall take precedence over scale measurements from drawings. Specifications shall take precedence over drawings.

.5 Any areas indicated as space for future materials or equipment shall be left clear.

1.5 QUALITY OF WORK

.1 All work shall be by qualified tradesmen with valid Trade Qualification Certificates. Spot checks will be made by the Engineer.

.2 Work which does not conform to standards accepted by the Engineer and the trade may be rejected by the Engineer. The Contractor shall redo rejected work to the accepted standard at no cost to the Owner.

1.6 METRIC CONVERSION

.1 All units in this division are expressed in SI units.

.2 Submit all shop drawings and maintenance manuals in SI units.

.3 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.

.4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:

.1 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

.5 Metric Duct Sizes:

.1 The Metric duct sizes are expressed as 25 mm = 1 inch.

1.7 SHOP DRAWINGS

.1 Refer to Section 01 33 00 Submittal Procedures.

.2 Identify materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalogue material. Do not assume applicable catalogues are available in the Engineer's office. Maintenance and operating manuals are not suitable submittal material.

.3 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g., ratings, capacities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps seals materials or painting.

.4 Include weights, dimensional, and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes.

.5 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Engineer.

.6 Do not order equipment or material until the Engineer has reviewed and returned shop drawings.

.7 Prior to submission to the Engineer, the Contractor shall review all shop drawings. By this review, the Contractor certifies that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data, and certifies that he has checked and coordinated each shop drawings with the requirements of the work of the contract documents. The Contractor's review of each shop drawing shall be indicated by stamp, date and signature of the Contractor' designated project manager.

.8 Retain one copy of shop drawings on site for review.

1.8 CUTTING, PATCHING AND CORING

.1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Structural Engineer before cutting or burning structural members.

.4 Provide openings and holes required in precast members for mechanical work. Cast holes 100 mm or larger in diameter. Field-cut smaller than 100 mm.

.5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.9 EQUIPMENT PROTECTION AND CLEAN-UP

.1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.10 CLOSEOUT SUBMITTALS

1 Provide operation and maintenance data for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

2 Operation and maintenance manual to be approved by, and final copies deposited with, Engineer before final inspection.

3 Operation data to include:

1 Control schematics for each system including environmental controls.

2 Description of each system and its controls.

3 Description of operation of each system at various loads together with reset schedules and seasonal variances.

4 Operation instruction for each system and each component.

5 Description of actions to be taken in event of equipment failure.

6 Valves schedule and flow diagram.

7 Colour coding chart.

.4 Maintenance data shall 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.

.5 Performance data to include:

.1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified elsewhere.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

.6 Submittals

.1 Submit two (2) copies of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless so directed by Engineer.

.2 Make changes as required and re-submit as directed by Engineer.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

Part 2 Products

2.1 EQUIPMENT AND MATERIALS

.1 Materials and equipment installed shall be new, full weight and of quality specified.

.2 Each major component of equipment shall bear manufacturer's name, address, catalogue and serial number in a conspicuous place.

.3 Where two or more products of the same type are required, products shall be of the same manufacturer.

2.2 ELECTRICAL MOTORS

.1 Supply mechanical equipment complete with electrical motors.

.2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be CSA labelled. All motors to be approved for use on the designated area classification by the Electrical Protection Branch of NWT.

.3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.

.4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.

.5 Motors 1/2 hp and under shall be 120 V, 60 Hz, 1 phase. Motors greater than 1/2 hp shall be 3 phase at the indicated voltage.

.6 All motors shall be 1800 rpm unless indicated otherwise.

.7 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.

.8 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.

.9 Refer to electrical specifications, Division 26, for voltage, frequency, and phase data. This shall take precedence over any reference in Division 21 or 23.

.10 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.

.11 Minimum certified motor efficiency shall be as outlined in the following table.

MINIMUM EFFICIENCY (%) *

HP	3600 RPM	**1800 RPM**	1200 RPM	900 RPM
1	75.5	82.5	80.0	74.0
1.5	82.5	84.0	85.5	77.0
2	84.0	84.0	86.5	82.5
3	85.5	87.5	87.5	84.0
5	87.5	87.5	87.5	85.5
7.5	88.5	89.5	89.5	85.5
10	89.5	89.5	89.5	88.5

(*) As defined in CSA C390 or IEEE 112B Nominal Standards

2.3 MISCELLANEOUS METALS

.1 Provide all necessary miscellaneous metals to hang or support materials, equipment and provide access for work under this contract.

.2 All miscellaneous metals shall be prime painted.

.3 Miscellaneous metals shall include but are not limited to:

.1 Hangers for equipment, piping and ductwork.

.2 Support for equipment.

2.4 PIPE SLEEVES

.1 Pipe sleeves shall be provided for piping passing through walls and floors. Minimum 0.61 mm (24 gauge) galvanised sheet metal. Sleeves shall extend 25 mm on either side of the wall.

.2 Schedule 40 steel pipe shall be used as floor pipe sleeves in wet areas with a 50 mm up-stand.

.3 Pipe sleeves are not required where pipes pass through cored concrete walls or floors.

2.5 ESCUTCHEON PLATES

.1 Provide escutcheon and plates on piping and ductwork passing through finished walls, floors and ceilings.

.2 Escutcheons shall be split type, stainless or chrome plated steel.

2.6 TEMPORARY HEAT

.1 The existing heating system will be maintained in operation by the Owner.

2.7 TEMPORARY OR TRIAL USAGE

.1 Temporary or trial usage by the Owner or Engineer of mechanical equipment supplied under contract shall not represent acceptance.

.2 Repair or replace permanent equipment used temporarily.

.3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

.4 Avoid thermal shock to heating system by coordination with the Owner during planning, construction and operation of temporary heating system.

2.8 INTERIM AND FINAL COMPLETION

.1 Prior to requesting an inspection for Substantial Completion, provide a complete list of items, which are deficient.

.2 A certificate of Final Completion will not be granted unless the following items are completed:

.1 Ventilating and plumbing systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation.

.2 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.

.3 Air systems have been balanced with draft report submitted to Engineer.

.4 Valve tagging and equipment identification is complete.

.5 Warranty forms have been mailed to the manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.

.6 Systems have been cleaned. Flush and initiate water treatment. Provide report from manufacturer's representative to confirm status of treatment.

.7 Draft Operating/Maintenance Manuals have been submitted.

.8 Operating and Maintenance demonstrations have been provided to the Owner.

.9 Record drawings have been submitted.

.10 All previously identified deficiencies have been corrected.

.3 Prior to Final Completion Inspection provide declaration in writing that deficiencies noted at time of substantial performance inspection have been corrected and the following items completed prior to the total performance inspection:

.1 Submit final air and water balance reports.

.2 Submit final operating and maintenance manuals.

.3 Complete final calibration.

.4 The Engineer shall provide one (1) visitation for the purpose of final inspection. Subsequent visitations if required shall be at the expense of the Contractor.

.5 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until substantial performance is declared.

2.9 ACCEPTABLE MANUFACTURERS

.2 It remains the responsibility of the contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.

.3 The contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment.

.4 Submit within fourteen (14) days of contract award a copy of the list underlining the name of the manufacturer whose price was carried in the tender. If no manufacturer's names are submitted, it will be assumed that the price carried in the tender was that of the specified manufacturer or where the specified product is generic, the first acceptable manufacturer listed for each item and equipment.

.5 Contractors to follow Northern Manufactured Product Directive.

Part 3 Execution

3.1 INSTALLATION OF EQUIPMENT

.1 Pipe all equipment drains to building drains.

.2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.

.3 Maintain permanent access to equipment for maintenance.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 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.

.3 Closeout Submittals:

- .1 Provide operation and maintenance data for incorporation into manual.
- .2 Operation and maintenance manual approved by, and final copies deposited with, Engineer before final inspection.
- .3 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.
- .4 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.
- .5 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.
- .6 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless directed by Engineer.
  - .2 Make changes as required and re-submit as directed Engineer.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 Mark changes as work progresses and as changes occur.

.2 Transfer information to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.9 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 Engineer 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.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

Part 2 Products

.1 Not used.

Part 3 Execution

3.1 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.

3.2 CLEANING

.1 Clean interior and exterior of all systems including strainers.

3.3 DEMONSTRATION

.1 Owner 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.

3.4 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 01 - Common Work Results for Mechanical.

.2 Section 23 05 05 - Installation of Pipework.

.3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)

.1 ANSI/ASME B16.15-13, Cast Bronze Threaded Fittings, Classes 125 and 250.

.2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.24-2016, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 600, 900, 1500 and 2500.

.2 ASTM International Inc.

.1 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM B88M-16, Standard Specification for Seamless Copper Water Tube (Metric).

.3 American National Standards Institute/American Water Works Association (ANSI)/ (AWWA)

.1 ANSI/AWWA C111/A21.11-2012, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International)

.1 CSA B242-05(R2016), Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67-2011, Butterfly Valves.

.2 MSS-SP-70-2011, Gray Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71-2011, Gray Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.

.8 National Research Council (NRC)/Institute for Research in Construction

.1 NRCC 476687, National Plumbing Code of Canada (NPC) - 2015.

.9 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 PIPING

.1 Domestic cold water distribution to be PVC Schedule 80 piping.

.1 Polyvinyl Chloride (PVC) Schedule 80 shall be manufactured to IPS dimensions and extruded using PVC 12454 compound as per ASTM D 1784. Pipe shall be certified by Canadian Standards Association to CSA B137.3, and shall be listed to NSF Standard 61 to ensure suitability for potable water. Pipe shall be gray in color.

.2 Molded PVC fittings shall conform fully to the following standards: Schedule 80 (socket) – ASTM D 2467 and Schedule 80 (threaded) – ASTM D 2464. Molded fittings shall be pressure rated at 60% of pipe pressure rating for that Schedule. Threaded pipe or fittings shall be rated at 50% of pipe pressure rating with the exception of metal reinforced female adapters which shall carry pressure ratings equal to that of the pipe. For threaded adapters between metal and PVC, the male end shall be mental and the PVC female adapter must have metal reinforcement.

.3 All fabricated PVC fittings shall be reinforced with fiberglass reinforced plastic (FRP) and shall be made from pipe meeting the above mentioned specifications including third party certification by CSA B137.3. Fabricated fittings shall indicate the name of manufacturer, size of fitting, pressure rating and thickness schedule all on the fitting exterior.

.4 PVC cements and primers shall be supplied and approved by the pipe manufacturer. Before starting construction, pipe and fitting installers must meet with a representative of the pipe and fitting manufacturer for consultation, instruction and training for proper PVC cementing procedure.

2.2 CAST IRON WAFER CHECK VALVES

.1 NPS 6, flanged:

.1 Check valve shall be manufactured out of ASTM A126 Class B cast iron and comply with API 594. Valve shall be pressure rated to 1379kPA (200psi) for sizes 50mm-300mm. Check calce construction with aluminum bronze disc plate, EPDM seat, 316 stainless steel spring, and PTFE bearings. Lead free cast iron water check valve shall be constructed using lead free materials.

.2 Such as Watts Series ICV-125-2-2-T or approved equivalent.

2.3 BUTTERFLY VALVES

.1 Installed on piping NPS 2 and over.

.2 Valves to be rated for domestic water use, with lead free assembly.

.3 Full lug type butterfly valves only.

.4 Such as Watts model DBF-3 or approved equivalent.

2.4 FLOW METER

.1 NSF-61 certified cast ductile iron alloy equaling or exceeding AWWA Standards such as those listed in ASTM A536 or ASTM A126, the main case shall be protected by a complete fusion-bonded coating conforming to AWWA C-550, all bolts and nuts made of stainless steel, working pressure of 175 PSI without leakage, seapage or distortion, factory sealed register electronically driven with a low flow leak detection and reverse flow notification symbol, measuring section shall be a unitized unit and completely integral to the meter body, two pairs of sensors are to be mounted in the chordal direct configuration in the measuring section to measure actual transit time of the initiated and reception-generated ultrasonic sound pulses, meters shall exceed current AWWA C-702 standards.

.2 Type: Ultrasonic flow meter

.3 Flow meter must be rated for cold water applications.

.4 Characteristics:

.1 Diameter: DN 4

.2 Flow range: 15-700GPM

.5 Acceptable products: Master Meter - Octave or approved equivalent.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install in accordance with NPC.

.2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.

.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

3.3 VALVES

.1 Isolate equipment, fixtures and branches with butterfly or ball valves, as indicated.

3.4 PRESSURE TESTS

.1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.

.2 Test pressure: greater of 1 time's maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, and then draw one sample off longest run. Submit to testing laboratory to verify that system is clean copper Federal potable water guidelines. Let system flush for additional 2 h, then draw off another sample for testing.

3.6 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.7 DISINFECTION

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.

.2 Upon completion, provide laboratory test reports on water quality for Engineer approval.

3.8 START-UP

.1 Timing: Start up after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Commission water conditioning specified Section 15 95 00 - Disinfection of Structures and Piping.

.4 Bring HWS storage tank up to design temperature slowly.

.5 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.

.6 Check control, limit, and safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.9 PERFORMANCE VERIFICATION

.1 Scheduling:

.1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Verify compliance with safety and health requirements.

.7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.2 COORDINATION

.1 Review the drawings prior to installation of piping, conduit services, and fixtures by this or any other division. Identify any conflicts and cooperate with the Engineer to determine the adjustments necessary to resolve these conflicts.

.2 Confirm the routing of each section of pipework with other services prior to commencement of installation. Advise the Engineer of any conflicts with existing services or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict and confirm with the Engineer.

.3 Process and Utility Piping Identification

.1 Refer to Section 23 05 53.01 –Mechanical Identification.

.4 Process and utility piping is identified in the drawings by a two component alpha-numeric code, (Line Label) as follows:

.1 The first component of the code indicates the nominal line size.

.2 The second component of the code identifies the process fluid being conveyed, (Commodity).

.3 The process fluid (Commodity) codes are defined in the drawings.

.5 Routing: Coordinate piping installation routes and elevations with installation of sheet metal, process equipment, HVAC, instrumentation, and electrical work.

.6 Pipe Sleeves: Coordinate with other divisions, prior to construction, to locate and place sleeves in cast-in-place concrete. Also, prior to construction of masonry building elements.

.7 Coordinate with Division 17 to provide correct piping configuration for primary instrumentation elements. For example, provide required minimum straight run of pipe upstream and downstream of flow meters. Coordinate with Division 17 for meter manufacturer's requirements.

1.3 SHIPMENT, PROTECTION AND STORAGE

.1 Refer to Section 01 60 10 – Material and Equipment.

.2 Deliver pipe, fittings, and specials to site using loading methods which do not damage pipe or coatings.

.3 Piping materials delivered to site will be clearly marked to indicate size, type, class/schedule and coatings.

.4 Until ready for incorporation in the work, store on site as recommended by the piping materials manufacturer to prevent damage, undue stresses, or weathering.

.5 Store materials at least 200 mm above ground with sufficient supports to prevent undue bending.

.6 Protect non-UV light inhibited plastic from sunlight.

.7 Ship pipe expansion joints, anchors, guides and flexible connectors pre-assembled to the degree which is practical.

.8 Provide shipping devices to maintain the face-to-face dimension of each expansion joint during shipment, storage and installation. Design and place shipping devices so as not to inhibit installation of the joints.

Part 2 Products

2.1 FITTINGS

.1 General

.1 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.

.2 Provide concentric reducers in vertical lines unless indicated otherwise.

.3 Provide long radius elbows unless otherwise shown. Provide smooth flow carbon or stainless steel elbows 350 min and less, to ANSI B 16.9. Provide mitered elbows greater than 350 mm, to AWWA C208 unless otherwise shown or specified. Use a-piece construction unless otherwise shown or specified.

.2 Steel Pipelines

.1 75 mm in diameter or greater: conform to ANSI B 16.9, ANSI B 16.11 or ANSI B 16.5. Provide fittings with a wall thickness equal to or greater than the pipe.

.2 Less than 75 mm in diameter: provide threaded malleable iron fittings, conforming to ANSI B16.3.

.3 Provide long radius steel grooved joint fittings conforming to ANSI B16.9 in steel grooved joint pipeline systems. Grooved joint adapters may be welded to fitting ends; dimension and cut the groove of the adapter in accordance with the coupling manufacturer's recommendations; materials and inside diameter to be the same as the pipe; grind the interior weld smooth and meet the lining manufacturer's recommendations.

.4 For steel grooved joint pipe of diameters of 150 mm and less, the Contractor may provide ductile iron grooved-joint fittings which have an outside diameter equal to the steel pipe diameter. Provide ductile iron to ASTM A536, dimensioned to 1.5 diameter radius bends, and cut grooving dimensions to AWWA C606 IPS dimensions. The lining and coating of the ductile iron fittings must equal the lining and coating of the steel pipeline system.

.5 Standard radius elbows to dimensions of ANSI B16.5 may be provided on clean water grooved-joint piping systems only.

2.2 CATHODIC PROTECTION

.1 Provide cathodic protection of piping, pipe fittings and appurtenances.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.4 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

.1 Install manual air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

- .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as indicated.

.14 Valves:

- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.
- .3 Install with stems above horizontal position unless otherwise indicated.
- .4 Valves accessible for maintenance without removing adjacent piping.
- .5 Use ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.

.15 Check Valves:

- .1 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRE STOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation.

.2 Uninsulated unheated pipes not subject to movement: No special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 Before start-up, clean interior of piping systems.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Engineer 72 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Pay costs for repairs or replacement, retesting, and making good. Engineer to determine whether repair or replacement is appropriate.

.6 Insulate or conceal work only after approval and certification of tests by Engineer.

3.13 CLEANING AND FLUSHING

.1 After installation and prior to testing, perform initial cleaning of process and utility lines. Clean piping greater than 150 mm and less than 600 mm by passing a tightly fitting cleaning ball or swab through the pipeline, unless specified otherwise. Lines greater than 600 mm may be cleaned manually or with a cleaning ball or swab. Give lines smaller or equal to 150 mm an initial flush or purge.

.2 After initial cleaning, connect the piping systems to related process and mechanical equipment. Insert temporary screens, provided with visible locator tabs, in the suction of pumps and compressors in accordance with the following table:

Suction Diameter, mm	Maximum Screen Opening, mm
0-25	1.5
30-75	6.25
80-150	12.5
>150	25

.3 Maintain the screens during testing, flushing/purging, initial startup, and the initial operating phases of the commissioning process. In special cases and with the Engineer's acceptance, screens may be removed for performance tests.

.4 Unless specified otherwise, flush liquid systems after testing, with clean water and screens in place. Maintain flushing for a minimum period of 15 minutes and until no debris is collected in the screens.

.5 Remove the screens and make the final connections after the screens have remained clean for a minimum of 24 consecutive hours of operation. Screens in solids handling systems are exempt; remove prior to placing the system in service.

.6 In air or gas systems with pipe sizes less than or equal to 150 mm, purge with air and/or inert gases before testing. Upon completion of testing and cleaning, drain and dry the piping with a dry air stream. Satisfy ANSI/ISA-S7.3 standards for instrument air systems.

.7 Brush clean steel pipe exterior to SSPC-P3 standard prior to painting.

3.14 DISINFECTION

.1 Disinfect lines intended for potable water service after testing in accordance with AWWA C651.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)

.1 ANSI/ASME B31.1-2014, Power Piping.

.2 ANSI/ASME B31.3-2014, Process Piping.

.3 ANSI/ASME Boiler and Pressure Vessel Code-2013:

.1 BPVC 2013 Section I: Power Boilers.

.2 BPVC 2013 Section V: Nondestructive Examination.

.3 BPVC 2013 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C206-11, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)

.1 AWS C1.1M/C1.1-2000(R2012), Recommended Practices for Resistance Welding.

.2 AWS Z49.1-2012, Safety in Welding, Cutting and Allied Process.

.3 AWS W1-2015, Welding Inspection Handbook..

.4 Canadian Standards Association (CSA International)

.1 CSA W47.2-11(R2015), Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51-14, Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA-W117.2-2012, Safety in Welding, Cutting and Allied Processes.

.5 CSA W178.1-2014, Certification of Welding Inspection Organizations.

.6 CSA W178.2-2014, Certification of Welding Inspectors.

1.2 QUALITY ASSURANCE

.1 Qualifications:

.1 Welders:

.1 Welding qualifications in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Submit welder's qualifications to Engineer.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors:

.1 Inspectors qualified to CSA W178.2.

.3 Certifications:

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

.4 Prior to the commencement of welding, submit current and complete documentation of the welder's qualifications.

.2 Weld Tests

.1 All piping welds shall be 100% visually inspected by a registered inspector and any imperfections shall be made good as required by the applicable Code and to the satisfaction of the Engineer.

.2 For piping required by the applicable Code to be subject to radiographic inspection, or for welds not found satisfactory during the Engineer's visual inspection provide for one full circumference radiographic inspection for every 20 welded pipe-to-pipe and pipe-to-fitting joints. All sizes and types of pipe welds to be tested at locations identified by the Engineer.

.3 Contractor to provide for one full circumference radiographic inspection for every 20 welded pipe-to-pipe and pipe-to-fitting joints. All sizes and types of pipe welds to be tested at locations identified by the Engineer.

.4 Have radiographic test firm evaluate welds in accordance with ANSI/ASME B31.3 Process Piping Code Normal Service and prepare report summarizing results.

.5 Have radiographic weld test report, complete with results, submitted directly to Engineer.

.6 For each defective weld, three additional radiographic inspections at locations identified by the Engineer, will be required plus a radiograph of the repair.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 QUALITY OF WORK

.1 Welding: in accordance with ANSI/ASME B31.1, B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified elsewhere in Division 23 and applicable requirements of territorial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Engineer before work is started.

.2 Do not conceal welds until they have been inspected, tested and approved by inspector.

.3 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

.1 General:

.1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Engineer.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.

.2 Hydrostatically test welds to ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of welds by visual examination, perform additional testing as directed by Engineer, selected at random.

.5 Full radiographic tests for piping systems.

.1 Spot radiography:

.1 Conduct spot radiographic tests of up to 10% of welds, selected at random from welds which would be most difficult to repair in event of failure after system is operational.

.2 Radiographic film:

.1 Identify each radiographic film with date, location, name of welder, and submit to Engineer. Replace film if rejected because of poor quality.

.3 Interpretation of radiographic films:

.1 By qualified radiographer.

.4 Failure of radiographic tests:

.1 Extend tests to welds by welder responsible when those welds fails tests.

3.6 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

.2 In addition:

.1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.

.2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.

.3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.

.4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.

.5 Repair cracks and defects in excess of 0.8mm in depth.

.6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic particle tests.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

.3 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP)

.1 IPMVP 2007 Version.

.4 Green Seal Environmental Standards (GS)

.1 GS-11-11, Standard for Paints and Coatings.

.2 GS-36-11, Standard for Commercial Adhesives.

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 thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Test and Evaluation Reports:

.1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 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 thermometers and pressure gauges off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid-point of scale or range.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to CAN/CGSB-14.4 and ASME B40.200.

.1 Resistance to shock and vibration.

.2 Thermostat to be installed on domestic water piping to be approve for installation on potable water.

2.3 THERMOMETER WELLS

.1 PVC pipe: stainless steel and certified for use on portable water.

.2 Steel pipe: stainless steel.

2.4 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Snubber for pulsating operation.

.2 Diaphragm assembly for corrosive service.

.3 Gasketted pressure relief back with solid front.

.4 Bronze stop cock.

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.

.2 Inform Engineer 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 from Engineer.

3.2 GENERAL

.1 Install thermometers and gauges so they can be easily read from floor or platform.

.1 If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.3 THERMOMETERS

.1 Install in wells on piping. Include heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:

.1 Heat exchangers.

.2 Water heating and cooling coils.

.3 Water boilers.

.3 Use extensions where thermometers are installed through insulation.

3.4 PRESSURE GAUGES

.1 Install in locations as follows:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of control valves.

.3 Inlet and outlet of coils.

.4 Inlet and outlet of liquid side of heat exchangers.

.5 Outlet of boilers.

.6 As indicated.

.2 Install gauge cocks for balancing purposes, elsewhere [as indicated].

.3 Use extensions where pressure gauges are installed through insulation.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling,

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by thermometer and gauge installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)

.1 ANSI/ASME B31.1-14, Power Piping.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A125-1996(2013)e1, Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-14, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-15, Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.6 Underwriter's Laboratories of Canada (ULC)

1.2 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by MSS SP58.ASME B31.1 or

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

1.3 SUBMITTALS

.1 Submit shop drawings and product data for following items:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.2 Quality assurance submittals:

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual.

Part 2 Products

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

.3 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade; provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.

.4 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.

.5 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.

.6 Fasten hangers and supports to building steel or "Z" roof purlin in pre-fabrication building or inserts in concrete construction.

.7 Provide and set sleeves required for equipment, including openings required for placing equipment. Provide sleeves for all pipe and duct penetrations through walls, ceilings, floors and footings.

.8 Dielectrically isolate dissimilar metals.

.9 Obtain approval from the Engineer prior to drilling for inserts and supports for piping systems.

.10 Obtain approval from the Engineer prior to using percussion type fastenings.

.11 Use of piping or equipment for hanger supports is not permitted.

.12 Use of perforated band iron, wire or chain as hangers is not permitted.

.13 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the Engineer and Structural Engineer.

2.2 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use electro-plating galvanizing process or hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm UL listed, 13 mm FM approved.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer.

.4 Hanger rods: threaded rod material to MSS SP58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.3 Do not use 22mm or 28mm rod.

.5 Pipe attachments: material to MSS SP58:

.1 Attachments for copper piping: copper plated black steel.

.2 Use insulation shields for hot pipework.

.3 Oversize pipe hangers and supports.

.6 Adjustable clevis: material to MSS SP69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.7 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.8 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black.

.2 Finishes for copper, glass, brass or aluminum pipework: with formed portion plastic coated or epoxy coated.

.9 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 INSULATION PROTECTION SHIELDS

.1 Insulated hot and cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

2.4 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.5 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.6 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 10 0mm larger than equipment; chamfer pad edges.

2.7 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel.

.2 Submit structural calculations with shop drawings.

2.8 INSERTS

.1 Inserts shall be malleable iron case or galvanised steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.

.2 Size inserts to suit threaded hanger rods.

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 datasheet.

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer’s instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 vertical movement of pipework is 13 mm or more,

.2 transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 transfer of load to adjacent piping or to connected equipment is not critical.

.2 variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper	Maximum Spacing PVC (100°F)/ HOPE
up to 1-1/4	2.1 m	1.8 m	1.0 m
1-1/2	2.7 m	2.4 m	1.3 m
2	3.0 m	2.7 m	1.5 m
2-1/2	3.6 m	3.0 m	1.6 m
3	3.6 m	3.0 m	1.6 m
3-1/2	3.9 m	3.3 m	2.0 m
4	4.2 m	3.6 m	2.0 m
5	4.8 m		
6	5.1 m		
8	5.7 m		
10	6.6 m		
12	6.9 m		

.7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Supply and installation of hangers and supports for all process piping systems specified in Section 23 05 05 - Installation of Pipework. This section does not include pipe support for fire sprinkling systems, pipe anchors, guides or seismic restraints.

.2 Engage a competent engineer to be responsible for the final aspects of the piping support system design, including details and spacing of all supports. The support system will ensure that the weight of the pipework and the need for lateral and vertical support are considered fully. Contractor to provide a complete piping system design as described in Section 23 05 05 - Installation of Pipework.

1.2 RELATED SECTIONS

.1 Section 23 05 05 - Installation of Pipework

1.3 SUBMISSIONS

.1 Submit the following for information in accordance with Section 01 33 00 - Submittal Procedures.

.1 In piping layout drawings specified in Section 23 05 05 - Installation of Pipework, indicate hanger and support locations and provide legend summarizing load information and hanger and support component selection at each location.

1.4 SERVICE CONDITIONS

.1 The intent of the drawings has been to indicate general arrangements and typical spacings for pipe systems, but does not relieve the Contractor of the responsibility for the design and supply of a complete and adequate support system.

.2 Provide hangers and supports specified in this Section to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this Section established pipe support classifications based on the operating temperature of the piping contents.

.3 Pipe support classifications:

.1 Hot Systems:

.1 A-1: 40°C - 230°C

.2 A-2: 230°C - 400°C

.3 A-3: Over 400°C.

.2 Ambient systems:

.1 B-1: 15°C - 49°C.

.3 Cold systems:

.1 C-1: 0.5°C - 15°C

.2 C-2: -40°C - 0°C.

1.5 HANGER AND SUPPORT SELECTION

.1 Piping supports are generally not shown on the process mechanical layout drawings. Therefore, select pipe hangers and supports as specified in this Section. Typical support details and structural attachments shown on the drawings indicate the level of quality that will be considered acceptable. Where specific supports are illustrated on the process mechanical or structural drawings or where a specific standard detail is noted on the drawings, provide that type of support for that particular pipeline.

.2 Piping insulation thickness is specified in Section 23 07 15 - Thermal Insulation for Piping.

.3 Review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.

.4 Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to following conditions:

.1 Weights of pipe, valves, fitting, insulating materials, suspended hanger components, and normal fluid contents.

.2 Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

.3 Reaction forces due to the operation of safety or relief valves.

.4 Wind, snow or ice loadings on outdoor piping.

.5 Size hangers and supports to fit the outside diameter of pipe, tubing, or where specified, the outside diameter of insulation.

.6 Where negligible movement occurs at hanger locations, use rod hangers for suspended lines, whenever practical. Use bases, brackets or structural cross members for piping supported from below.

.7 Hangers for the suspension of pipe and tubing sizes, 65mm and larger shall be capable of vertical hanger component adjustment under load.

.8 Provide the supporting systems to allow for free or intended movement of the piping including its movement in relation to that of connected equipment.

.9 Design the system to support the operating loads with a safety factor of 4.0.

.10 Where there is horizontal movement at a suspended type hanger location, select hanger components to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.

.11 No contact is allowed between a pipe and hanger or support components of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing with copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.

.12 Do not support piping from masonry wall construction.

.13 Do not use existing pipes and supports to support new piping unless otherwise specified.

.14 Do not attach pipe support components to equipment or pressure vessels unless otherwise specified.

.15 Use stock hanger and support components wherever practical.

.16 Provide supplementary structural members, where structural bearings are not in suitable locations.

.1 Make provision for expansion, contraction, slope and anchorage.

.2 Where necessary, pipe support systems shall withstand the additional load of electrical or instrumentation trays. Coordinate with other divisions. Design and provide support system accordingly.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 The following manufacturer's products to provide the specified features and to meet specified operating conditions:

.1 B-Line

.2 Grinnell

.3 Powerstrut

.4 Superstrut

.5 Unistrut.

2.2 SUPPORT SPACING

.1 Maximum support spacing shall be as listed in the following table:

Pipe Size Nominal (mm)	Maximum Spacing (m)		
	Iron	PVC	Steel or Stainless Steel
30 and under	2.1	1.4	2.1
30 to 40	2.7	1.5	2.1
40 to 50	3.0	1.6	2.1
60 to 75	3.6	1.8	3.0
100	4.2	2.5	3.7
150	5.2	3.0	4.3
200	5.8	3.5	4.6
250	6.4	4.0	4.9
300	6.7	4.2	5.2
350	6.7		5.8
400	6.7		6.1
500	6.7		6.7
600 and greater	6.7		6.7

.2 Provide additional supports at any valves or other heavy piping element.

2.3 MATERIALS

.1 Non-Corrosive Environments (Tunnels and Buildings):

.1 Unless otherwise specified, pipe hangers and supports, structural attachments, fittings and accessories are hot-dipped galvanized after fabrication.

.2 Provide cadmium plated hardware (nuts, bolts, washers, threaded rods).

.3 Touch up cadmium and galvanized material with zinc rich coating where the material has been cut. Exposed bare steel is not acceptable.

.2 Exterior, Submerged or Corrosive Environments:

.1 Pipe hangers, supports, structural attachments, fittings, accessories and hardware are all stainless steel.

.2 Any areas that may be considered corrosive and are in question should be reviewed with the Engineer in advance of securing the materials.

.3 Provide AISI, Type 304 stainless steel concrete inserts.

2.4 PIPE HANGERS AND SUPPORTS

.1 Type 1 - Clevis Pipe Hanger: Provide carbon steel clevis hangers with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3100, Grinnell Figure 260, Superstrut C-710 or Unistrut No. 24 with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3100, Grinnell Figure 260, Superstrut C-710 or Unistrut No. 24.

.3 Cast and ductile iron pipe - B-Line B3102, Grinnell Figure 590, Superstrut C-710 or Unistrut No. 24.

.4 Copper pipe (uninsulated) - shall be B-Line B3104 CT, Grinnell Figure CT-65, Superstrut C-710 or Unistrut No. 51.

.5 Copper pipe (insulated) - B-Line B3100, Grinnell Figure 260, Superstrut C-710 or Unistrut No. 24, with insulation shield.

.6 Plastic pipe - B-Line B3100, Grinnell Figure 260 or Unistrut No. 56.

.2 Type 2 - "J" Pipe Hanger: Provide carbon steel hangers with configuration and components equivalent to MSS Type 5. Use only on uninsulated pipe, with configuration and components as follows:

.1 Steel pipe - B-Line B3690, Grinnell Figure 67, Superstrut C-711 or Unistrut J1205- J1280 Series.

.2 Copper and plastic pipe - B-Line B3690 (Plasticoat) Grinnell Figure 67 (plastic coated), Superstrut C-711P or Unistrut J 1205N-J1280N series.

.3 Type 3 - Double Bolt Pipe Clamp: Provide carbon steel pipe clamps, with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3144 or Grinnell Figure 295, with insulation shield. Insulation shield is optional for hot and ambient systems.

.2 Steel pipe (uninsulated - B-Line B3144 or Grinnell Figure 295.

.3 Copper pipe (insulated only) - B-Line 3144 or Grinnell Figure 295, with insulation shield.

.4 Type 4 - Adjustable Roller Hanger: Provide cast iron rollers, carbon steel yoke and cross bolt with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3110, Grinnell Figure 181 or Superstrut C-729, with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3110, Grinnell Figure 181 or Superstrut C-729.

.3 Copper pipe (insulated only) - B-Line B3110, Grinnell Figure 181 or Superstrut C-729, with insulation shield.

.4 Plastic pipe - B-Line B3110, Grinnell Figure 181 or Superstrut C-729.

.5 Type 5 - Single Pipe Roll: Provide cast iron rollers and sockets, and steel cross rods with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3114, Grinnell Figure 171 with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3114, Grinnell Figure 171.

.3 Plastic pipe - B-Line B3114, Grinnell Figure 171.

.6 Type 6 - Framing Channel Pipe Clamp: Provide steel pipe clamps with hot dipped galvanized finish and material thickness as listed below:

.1 Steel pipe (uninsulated) - B-Line 2007, Powerstrut PS1100, or Unistrut P1009 Series:

Pipe Diameter mm	Thickness mm
10 and 12	1.6
20 to 32	2.0
38 to 75	2.8
90 to 125	3.2
150 to 200	3.6

.2 Steel pipe (insulated); as per 2.4.6.1 with insulation shield.

.3 Copper (uninsulated) and plastic pipe, B-Line B2033 Series, Powerstrut PS 1200 or Unistrut P2024C and P2024PC Series B-Line. Provide a copper-plated, plastic coated or lined with a dielectric material on pipe clamps.

Pipe Diameter mm	Thickness mm
10 to 25	1.6
32 and 38	2.0
50 to 75	2.8
100	3.2

.4 Copper (insulated); as per 2.4.6.3 with insulation shield.

.7 Type 7 - U-Bolt: Provide carbon steel U-bolts with configuration as follows:

.1 Steel pipe (uninsulated) - Grinnell Figure B-Line B3188 or Superstrut H-115.

.2 Steel pipe (insulated) - Grinnell Figure 137, B-Line B3188 or Superstrut H-115 with insulation shield.

.3 Cast and ductile iron pipe - Grinnell Figure 137, B-Line B3188 or Superstrut H-115.

.4 Copper pipe (uninsulated) - B-Line B3501 CT, Grinnell Figure 137C, Superstrut H115 (with plastic coating) or Unistrut No. 13 (with plastic coating).

.5 Copper pipe (insulated) - Grinnell Figure 137 or B-Line B3188, Superstrut H-115 with insulation shield.

.6 Plastic pipe - Grinnell Figure 137C, B-Line B3188 or Superstrut H-115 (with plastic coating).

.8 Type 8 - Adjustable Pipe Roll Support: Provide cast iron rollers and sockets, and carbon steel cross rod and support rods with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3122 or Grinnell Figure 177 with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3122 or Grinnell Figure 177.

.3 Copper pipe (insulated only) - B-Line B3122 or Grinnell Figure 177 with insulation shield.

.4 Plastic pipe - B-Line B3122 or Grinnell Figure 177.

.9 Type 9 - Welded Pipe Stanchion: Provide a carbon steel, standard schedule pipe stanchion, cut pipe to match contour of pipe elbow. Use only for ambient commodity systems.

.10 Type 10 - Pipe Stanchion saddle: Provide carbon steel saddles and yokes as follows:

.1 Steel pipe (insulated) - B-Line B3900 or Grinnell Figure 259 with insulation shield.

.2 Steel pipe (uninsulated) - B-Line 3090 or Grinnell Figure 259.

.3 Cast and ductile iron pipe - B-Line 3090 NS or Grinnell Figure 259.

.4 Copper pipe (uninsulated) - B-Line B3090 or Grinnell Figure 259 with insulation shield or lined with dielectric material.

.5 Copper pipe (insulated) - B-Line B3090 or Grinnell Figure 259 with insulation shield.

.6 Plastic pipe - B-Line B3090 or Grinnell Figure 259.

.11 Type 11 - Offset Pipe Clamp: Provide carbon steel pipe clamps with con-figuration and components as specified and to the most standard design manufactured by a pipe hanger component manufacturer:

.1 Steel pipe (insulated) - B-Line B3148 or Grinnell Figure 103 or with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3148 or Grinnell Figure 103.

.3 Cast and ductile iron pipe - B-Line B3148 NS or Grinnell Figure 103.

.4 Copper pipe (insulated) - B-Line B3148 or Grinnell Figure 103 or with insulation shield.

.5 Copper pipe (uninsulated) - B-Line B3148 or Grinnell Figure 103 lined with dielectric material.

.6 Plastic pipe - B-Line B3148 or Grinnell Figure 103.

.12 Type 12 - Riser Clamp: Provide carbon steel riser clamps with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3373 or Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82.

.2 Steel pipe (uninsulated) - B-Line B3373 or Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82.

.3 Cast and ductile iron pipe - B-Line B3373 or Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82

.4 Copper pipe (insulated) - B-Line 83373 CT, Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82.

.5 Copper pipe (uninsulated) - B-Line B3373 CT, Grinnell Figure CT-261, Superstrut C-720 or Unistrut No. 84.

.6 Plastic pipe - B-Line B3373, Grinnell Figure 261C, or Superstrut C-720 or Unistrut No. 82.

.13 Type 13 - Framing Channel Pipe Strap: Provide carbon steel pipe strap with configuration as follows:

.1 Steel pipe (uninsulated) - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series.

.2 Steel pipe (insulated) - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series with insulation shield.

.3 Copper pipe (uninsulated) - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series with insulation shield.

.4 Copper pipe (insulated) - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series with insulation shield.

.5 Plastic pipe - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series.

.14 Rack and Trapeze Supports:

.1 Unless otherwise specified, provide steel trapeze and pipe rack components having a minimum thickness of 2.8 mm with a maximum deflection 1/240 of the span. Framing channel as specified in 2.4.16.5.

.2 Type 20 - Trapeze Pipe Support: Trapeze pipe support cross members as specified in 2.4.16.5. Provide 41mm square carbon steel flat plate fittings of stranded design manufactured by framing channel manufacturer, B-Line B202-2, Powerstrut PS619 or Unistrut P1062 Series.

.3 Type 21 - Pipe Rack Support: Post and cross member framing channels, as specified in 2.4.16.5. Provide carbon steel pipe rack fittings of standard design manufactured by framing channel manufacturer. Provide gusset type, 90-degree fittings, B-Line B844, Grinnell PS3373 or Unistrut P2484. Post base fittings as specified in 2.4.15.14.

.15 Structural Attachments:

.1 Type A - Malleable Iron Concrete Insert: Provide malleable iron concrete inserts; B-Line B3014, Grinnell Figure 282 or Unistrut M2808,

.2 Type B - Side Beam Bracket: Provide malleable iron bracket; Grinnell Figure 202 or B-Line B3062.

.3 Type C - Malleable Beam Clamp with Extension Piece: Provide malleable iron clamp and extension pieces with steel tie rods; Grinnell Figure 218 with Figure 157 extension piece or B-Line B3054.

.4 Type D - Steel Beam Clamp with Eye Nut: Provide forged steel beam clamps and eye nuts; Grinnell Figure 292, B-Line B3291 series.

.5 Type E - Steel channel clamp: Provide malleable iron clamp and heel plates, and steel bolts and nuts; Grinnell Figure 226.

.6 Type F - Welded Beam Attachment: Provide carbon steel beam attachments; B-Line B3083 or Grinnell Figure 66.

.7 Type G - Adjustable Beam Attachment: Provide carbon steel beam attachments, B-Line B3082, Unistrut P1737 or Powerstrut PS2648.

.8 Type H - Double Channel Bracket: Provide single channel attachment as specified in 2.4.16.5. Provide a carbon steel double framing channel cantilever bracket assembly; B-Line B297-12 through B297-36, Powerstrut PS809 or Unistrut P2542 series.

.9 Type J - Single Channel Bracket: Provide single channel attachment as specified in 2.4.16.5. Provide a carbon steel single framing channel cantilever bracket assembly; B-Line B198-6 through B198-24, Powerstrut PS661 or Unistrut P2231 through P2234.

.10 Type K - Wall Mounted Channel: Provide 41mm x 62mm carbon steel framing channel; B-Line B12 or Unistrut P5500.

.11 Type L - Pipe Stanchion Attachment: Provide minimum 12mm thick carbon steel baseplate. Anchor bolt holes: 1.6mm larger than bolt diameter. Provide non-shrink grout between the baseplate and upstand.

.12 Type M - Welded Steel Bracket: Provide carbon steel brackets which comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket: Grinnell Figure 195. Heavy welded bracket to comply with MSS Type 33 and FEDSPEC Type 34; Grinnell Figure 199.

.13 Type N - Cast Iron Bracket: Provide cast iron brackets; Grinnell Figure 213.

.14 Type P - Framing Channel Post Base: Provide carbon steel post bases of stranded design manufactured by framing channel manufacture. Single channel: Unistrut P2072A, B-Line B280 Powerstrut PS3025. Double channel: Unistrut P2073A, B-Line B281 or Powerstrut PS3064.

.15 Type Q - Continuous Concrete Inserts: Provide 300 mm long carbon steel concrete inserts; Unistrut P3253.

.16 Accessories:

.1 Weldless Eye Nut: Provide forged steel eye nuts and comply with MSS and FEDSPEC Type 17; Grinnell Figure 290 or B-Line B3200.

.2 Welded Eye Rod: Provide carbon steel eye rods with eye welded closed. Inside diameter of eye to accommodate a bolt diameter 3.2 mm larger than the rod diameter; Grinnell Figure 278 or B-Line B3211.

.3 Turnbuckle: Provide forged steel turnbuckles; Grinnell Figure 230 or B-Line B3202.

.4 Framing Channels: Provide 41 mm x 62 mm roll formed carbon steel framed channel, having a thickness of 2.7 mm. Channel to have a continuous slot along one side with in-turned clamping ridges. Single Channel: Unistrut P5500. Double Channel: Unistrut P5501.

2.5 HANGER RODS

.1 Rod material shall conform to ASTM A307 as a minimum, and shall be cadmium plated in non-corrosive interior spaces, stainless steel in exterior, submerged or corrosive applications, threaded on both ends or continuous threaded and sized as specified.

.2 Hanger rod sizing, as a minimum shall be as follows:

Pipe Size Nominal (mm)	Hanger Rod Diameter (mm)
50	10
75	12
100	16
150	20
200	22
250	25
300	25
400	29
500	38
600	44

2.6 BASE ELBOWS

.1 Where elbows change the run of a horizontal pipe to a vertical direction, supports shall be secured to the elbow.

.2 Dimensions for the supports shall be as follows

Pipe Size Nominal (mm)	Support Pipe Diameter (mm)	Base Plate (mm x mm)
100	50 Schedule 40	100 x 6
150	75 Schedule 40	125 x 6
200	100 Schedule 40	150 x 6
250	100 Schedule 40	150 x 6
300	150 Schedule 40	200 x 10
350	200 Schedule 40	250 x 10
400	200 Schedule 40	250 x 10
500	250 Standard Weight	300 x 10
600	300 Standard Weight	350 x 10
750	350 Standard Weight	400 x 10
1050	350 Standard Weight	400 x 10

.3 Gauge piping: In general, support elbow stanchions for gauge stainless steel piping shall be of the same diameter as the pipe.

2.7 THERMAL PIPE HANGER SHIELD

.1 Provide thermal shields at hanger, support and guide locations on pipe requiring insulation. The shield consists of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer. The thermal shield is the same thickness as the piping system insulation. Use standard shield for hot systems and vapour barrier shield for cold systems. Use stainless steel band clamps to ensure against slippage between the pipe wall and the thciuial shield.

.2 Standard Shield:

.1 Insulation:

.1 Hydrous calcium silicate, high density, waterproof.

.2 Compressive strength: 700 kPa average.

.3 Flexural strength: 500 kPa average.

.4 R unit: 2.16 at 37.8°C mean.

.5 Temperature range: -7°C to 260°C.

.6 Steel Jacket: Galvanized steel, thickness as per manufacturer's standards, supplied for the given pipe size.

.7 Connection: Provide butt connection shield to pipe insulation. Steel jacket and insulation to be flush with end.

.2 Vapour Barrier Shield:

.1 Insulation:

.2 Hydrous calcium silicate, high density, waterproof.

.1 Compressive strength: 700 kPa average. Flexural strength: 500 kPa average. R. unit: 2.16 at 37.8°C mean. Temperature range: -7°C to 260°C.

.3 Steel Jacket: Galvanized steel, thickness as per manufacturer's standards, supplied for the given pipe size.

.4 Connection: Provide butt connection shield to pipe insulation. Insulation to extend 25mm each side of steel jacket for vapourtight connection to pipe insulation vapour barrier.

Part 3 Execution

3.1 HANGER AND SUPPORT LOCATION

.1 Locate hangers and supports as near as possible to concentrated loads such as valve, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths specified on drawings to support continuous pipeline runs unaffected by concentrated loads.

.2 Provide hangers and/or base supports within one metre of each change in direction on each leg, on one side of each valve, and on the first spool piece or fitting extending from a piece of equipment.

.3 Locate hangers and supports to ensure that connections to equipment, tanks, etc. are substantially free from loads transmitted by the piping.

.4 Ensure that where piping is connected to equipment, a valve, piping assembly etc. that will require removal for maintenance, the piping will be supported in such a manner that temporary supports will not be necessary for this procedure.

.5 Support piping so that no pockets will be formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

.6 Install spring hangers where required to offset expansion in horizontal runs which follow long vertical risers.

3.2 INSTALLATION

.1 Unless otherwise specified, do not drill or bum holes in the building structural steel.

.2 Do not use hanger components for purposes other than for which they were designed. Do not use hanger components for rigging and erection purposes.

.3 Install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

.4 Aluminum or galvanized steel clips shall be used to support piping from aluminum or steel structural members. Where metals of different type are to be connected, provide isolation to prevent galvanic corrosion.

.5 Use embedded anchor bolts instead of concrete inserts for support installation in areas below water surface or normally subjected to submerging.

.6 Install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the tie of insulation installation in accordance with the manufacturer's recommendation.

.7 All minor modifications to accommodate installed equipment and structural components are subject to review. Do not commence work on related piping until written acceptance has been received.

.8 Include any piping support modifications on the shop drawings submitted prior to fabrication or installation.

.9 Prior to installation, inspect and field measure to ensure that previous work is not prejudicial to the proper installation of piping.

.10 Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.

.11 Rollers shall roll freely without binding.

.12 Finished floor beneath Type L structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of void of foreign material.

.13 Cut and drill baseplates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

.14 Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 2100 mm above the floor.

.15 Review the drawings prior to installation of ping, conduit, and fixtures by this or any other division. Identify any conflicts and confirm the routing of each section of pipe work prior to commencement of installation. Advise of any conflicts with existing services. Where necessary, amend the routing of pipework to avoid conflict and provide shop drawings showing proposed routing.

3.3 ADJUSTMENT

.1 Adjust hangers and supports to obtain required pipe slope and elevation. Use shims made of material that is compatible with the piping material. Adjust stanchions prior to grouting of baseplates.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CAN/CGSB-24.3-92, Identification of Piping Systems.

.2 ANSI/ASME A13.1-2007, Scheme for the Identification of Piping Systems.

1.2 SAMPLES

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

.2 Submit samples and lists of proposed wording for approval before engraving.

Part 2 Products

2.1 MANUFACTURERS' NAMEPLATES

.1 Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.

.2 Indicate size, capacity rating, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

2.2 SYSTEM NAMEPLATES

.1 Colour:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where noted in these Specifications and as required otherwise by applicable codes).

.2 Use self-sticking vinyl tape pipe markers.

.3 Use self-sticking vinyl tape direction arrow markers for indicating flow direction.

2.3 PIPING

.1 General:

.1 To CAN/CGSB-24.3.

.2 Do not paint PVC piping, use bands to identify pipe commodities and show flow direction.

.3 Identify medium by lettered legend, classification by primary colours only, direction of flow by arrows.

.2 Sizes:

.1 Legend: block capitals to following table:

Outside Diameter of Pipe (mm)	Size of Letters (mm)	Length of Colour Field (mm)
12	6	150
20	12	200
30	12	200
50	20	200

Outside Diameter of Pipe (mm)	Size of Letters (mm)	Length of Colour Field (mm)
150	30	300
250	60	600
Over 250	75	800

3 Arrows:

.1 Outside diameter of pipe 75 mm and greater: 150 mm long x 50 mm high.

.2 Outside diameter of pipe 32 mm to 75 mm: 100 mm long x 50 mm high.

.3 Outside diameter of pipe 25 mm and smaller: 50 mm long x 12 mm high.

.4 Use double headed arrows where flow is reversible.

.4 Material:

.1 Legend markers, arrows and colour bands: pressure sensitive self-sticking vinyl tape with protective overcoating and waterproof contact adhesive undercoating, suitable for 100% RH and continuous operating temperature of 150 C and intermittent temperature of 200 C. Apply to dry, clean prepared surfaces. Wrap tape around pipe or pipe covering with ends overlapping 1 pipe diameter.

.2 Valve tags, harsh environment equipment tags (H.E.E.T.), 50 mm x 50 mm size, format H6.

.3 Acceptable material supplier: W.H. Brady Inc.

2.4 VALVES AND CONTROLLERS

.1 Plastic tags with 12 mm stamped code lettering and numbers filled with black paint.

.2 Furnish Engineer with two (2) typical identification flow markers and tags of specified size for each system complete with lettering for approval before ordering all tags and markers. Include valve tag schedule, designating station site acronym, valve number, service and function of each tagged item and normal operating position of valves.

.3 Add identification plates behind fill valves in kiosks as shown on Drawings. Size: 200 mm x 150 mm, letter size 10 mm.

2.5 CONTROLS IDENTIFICATION

.1 Identify all systems, equipment, components, controls and sensors.

.2 Inscription to identify station site number, function and (where applicable) fail-safe position.

Part 3 Execution

3.1 GENERAL

.1 Do identification work in accordance with CAN/CGSB-24.3, except where specified otherwise.

.2 Provide ULC and CSA registration plates, as required by respective agency.

3.2 LOCATION OF NAMEPLATES

.1 In conspicuous location to facilitate easy reading from operating floor and to properly identify equipment and system.

.2 Provide stand-offs for nameplates on hot surfaces.

3.3 PIPING

.1 Locations:

.1 On straight runs in open areas in equipment rooms, so that at least one is clearly visible from any one viewpoint in operating areas or walking aisles and not at more than 3 m intervals.

.2 Adjacent to all changes in direction.

.3 At least once in each room through which piping passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of any separation such as walls, floors and partitions.

.6 Where piping is concealed in pipe chase, ceiling space, gallery or other confined space, at entry and leaving points and adjacent to each access opening.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves. Where this is not possible, place identification as close to valve as possible, preferably on upstream side.

.9 Legend to be easily and accurately readable from usual operating areas and all readily accessible points.

.10 Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.

3.4 VALVES AND CONTROLLERS

.1 Secure tags with plastic or nylon straps for valves and operating controllers.

.2 Number valves in system in accordance with P&ID's.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 TAB means to test, adjust and balance 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 Engineer.

.2 Provide documentation confirming qualifications, successful experience.

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 Adjust and regulate systems and equipment to regulate flow rates to match load requirements over full operating ranges.

.4 Adjust and regulate water flows and pressure drop through cooling and heating coils of air handling systems.

.5 To demonstrate air tightness of air distribution systems.

.6 Note and present results in a report.

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 project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Engineer adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Engineer in writing all proposed procedures, which vary from standard.

.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 Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

1.9 START OF TAB

.1 Notify Engineer 7 days prior to start of TAB.

.2 Start TAB when work is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weatherstripping, sealing, caulking.

.3 All pressure, leakage, other tests specified as per Section 23 05 94 – Pressure Testing of Ducted Air Systems.

.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 Duct systems clean.

.2 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.3 Correct fan rotation.

.4 Fire, smoke, volume control dampers installed and open.

.5 Access doors, installed, closed.

.6 Outlets installed volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5%, minus 5%.

.2 Hydronic systems: plus or minus 10 %.

1.11 ACCURACY TOLERANCES

.1 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to 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.

1.13 TAB REPORT

.1 TAB report to show results in SI units:

.2 Air systems TAB report shall include:

.1 Design characteristics:

.1 Identification.

.2 Air/water flows.

.3 Fan's static pressure.

.4 Motor size (kW).

.5 Brake horse power.

.6 Fan/pump speed.

.2 Characteristics of installed equipment:

.1 Manufacturer, model, serial number.

.2 Unit size.

.3 Arrangement.

.4 Motor nameplate:

.1 Power.

.2 Tension.

.3 Number of phases.

.4 Frequency.

.5 FLA.

.6 Speed.

.3 Tests results:

.1 Fan speed.

.2 Power reading at motor connections (tension and current for each phase).

.3 Pressure at fan's suction and discharge.

.4 Air flow.

.5 Fan curve indication operating point as per measurements.

.4 Additional information:

.1 Dimension and number of belts.

.2 Dimension of pulleys.

.3 Motor speed at full load.

.4 Adjustment of overload protections.

.5 Measured Flows:

.1 At main supply ducts

.2 At main return ducts

.3 At branch locations

.6 Pressure readings:

.1 At branch locations

.2 Above ceiling

.7 System's schematics.

.3 Submit 6 copies of TAB Report to Engineer for verification and approval, in French or English, in D-ring binders, complete with index tabs. Final TAB report shall be submitted in both official languages.

1.14 VERIFICATION

.1 Reported results subject to verification by Engineer.

.2 Number and location of verified results to be at discretion of Engineer.

.3 Bear costs to repeat TAB as required to satisfaction of Engineer.

1.15 SETTINGS

.1 After TAB is completed to satisfaction of Engineer, replace drive guards, close access doors, lock devices in set positions, 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.

1.16 COMPLETION OF TAB

.1 TAB to be considered complete when final TAB Report received and approved by Engineer.

1.17 AIR SYSTEMS

.1 Standard: TAB to be to most stringent of this section or TAB standards of AABC and SMACNA.

.2 Do TAB of systems, equipment, components, controls for all air systems on:

.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, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.18 OTHER TAB REQUIREMENTS

.1 Building pressure conditions:

.1 Adjust HVAC systems, equipment, controls to ensure specified design pressure conditions at all times.

.2 Zone pressure differences:

.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible combinations of normal operating modes.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Duct thermal insulation.

.2 Breeching insulation.

.3 Adhesives, tie wires, tapes.

.4 Recovery.

1.2 QUALITY ASSURANCE

.1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.

.2 Materials shall meet fire and smoke hazard ratings as stated in this section and defined in applicable current building codes.

1.3 SUBMITTALS

.1 Submit shop drawings which indicate complete material data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

1.4 JOB CONDITIONS

.1 Deliver materials to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement, poor workmanship or material defects.

1.5 ALTERNATIVES

.1 Alternative insulations are subject to approval. Alternatives shall provide the same or better thermal resistance at normal conditions as material specified.

Part 2 Products

2.1 GENERAL

.1 Insulation Material, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives: Composite fire and smoke hazard ratings shall not exceed 25 from flame spread and 50 for smoke developed.

.2 Insulating materials and accessories shall withstand service temperatures without smouldering, glowing, smoking or flaming.

.3 Recovery Jackets:

.1 ULC labelled thermo-canvas.

.4 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

2.2 MATERIALS

.1 Exposed Rectangular Ducts: Rigid fibrous glass or mineral fibreboard insulation, "K" value maximum 0.035 W/m.°C at 24°C. Factory applied reinforced aluminum foil vapour barrier for cold ducts.

.2 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass or mineral fibre insulation, "K" value maximum 0.035 W/m.°C at 24°C. Factory applied reinforced aluminum foil vapour barrier for cold ducts.

.3 Breeching Insulation: Semi-rigid mineral fibre insulation with glass mat "K" value 0.035 W/m.°C maximum at 24°C. Service temperature 65°C to 450°C.

Part 3 Execution

3.1 PREPARATION

.1 Do not install covering before ductwork and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions where possible.

3.2 INSTALLATION

.1 Ensure insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation materials, properly sealed.

.2 Finish insulation neatly at hangers, supports and other protrusions.

.3 Locate insulation or cover seams in least visible locations. Locate seams on ductwork in ceiling spaces on the underside of the duct.

.4 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Make smooth any uneven insulated surface before recovering.

.5 Exposed Rectangular Ducts: Secure rigid insulation with galvanised anchors or welded pins on 400 mm centres. Secure in place with retaining pins. Seal all insulation joints and breaks with joint tape. Seal adhesive; cover joints with 100 mm strips of open mesh cloth imbedded between two coats of lap seal adhesive. Use vapour barrier tape for insulation joints or breaks on cold ducts.

.6 Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 150 mm wide strips on 400 mm centres. Provide annealed tie wire tied at 400 mm centres for securing duct insulation. Butt insulation and seal joints and breaks with lap seal adhesive; cover joints with joint tape. Use vapour barrier tape for cold ducts.

.7 Where duct velocities exceed 15 m/s, cover internal duct insulation with 0.8 mm perforated galvanised steel with 24% free area.

.8 Breeching Insulation: Face breeching with 9.5 mm rib lath turn out to provide 12 mm space between insulation and hot surface and 12.5 mm mesh expanded lath on the outside. Butt blankets firmly together and secure with 1.6 mm galvanised wire. Lace metal mesh together. Coat with 12 mm thick insulating cement. Finish with a final 12 mm coat of insulating cement. Trowel to a smooth hard finish. Recover with aluminum jacket.

3.3 INSULATION INSTALLATION THICKNESS SCHEDULE

Ducts and Equipment		Insulation Thickness (m)	Recovery Jacket
.1	Combustion Air	50	Canvas
.2	Exhaust Ducts within 3000 mm of Exterior Walls or Openings	50	Canvas
.3	Outside Air Intake Ducts	50	Canvas

END OF SECTION

Part 1 General

1.1 QUALITY ASSURANCE

.1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.

.2 Materials shall meet or exceed fire and smoke hazard ratings as stated in this section and defined in applicable building codes.

1.2 SUBMITTALS

.1 Submit shop drawings which indicate complete material data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

1.3 JOB CONDITIONS

.1 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.4 ALTERNATIVES

.1 Alternative insulations are subject to approval. Alternatives shall provide the same or better thermal resistance at normal conditions as material specified.

Part 2 Products

2.1 GENERAL

.1 Insulation Materials, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives: Composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed.

.2 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

.3 Insulate fittings and valve bodies with preformed removable insulated fittings.

2.2 MATERIALS

.1 Cold Piping: Formed fine fibrous glass or formed mineral fibre pipe insulation, with factory applied vapour barrier jacket, factory moulded to conform with piping, "K" value maximum 0.035 W/m. °C at 24°C. Service temperature up to 100°C.

.2 Hot Piping: Formed fine fibrous glass or mineral fibre pipe insulation, with factory applied general purpose jacket, factory moulded to conform to piping, "K" value maximum 0.035 W/m. °C at 24°C. Service temperature up to 150°C

.3 Vents: Flexible fibrous glass or mineral fibre insulation, "K" value maximum 0.035 W/m. °C at 24°C with factory applied reinforced aluminum foil vapour barrier. Service temperature -14°C0 to 50°C.

.4 Engine Exhaust: Formed rigid hydrous calcium silicate insulation, moulded to conform to piping, "K" value maximum 0.059W/m.°C at 93°C. Service temperature up to 750°C.

.5 Recovery Jackets:

.1 ULC labelled thermo-canvas flamespread less than 25, smoke developed less than 50.

.2 0.9 mm smooth aluminum sheet for engine exhaust.

Part 3 Execution

3.1 PREPARATION

.1 Do not install covering before piping and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 INSTALLATION

.1 Insulate new piping, fittings and valves. Do not insulate unions, flanges (except on flanged valves), "victaulic" couplings, strainers, flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

.2 Finish insulation neatly on hangers, supports and other protrusions.

.3 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.

.4 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Make smooth uneven insulated surfaces before recovering.

.6 Cold Piping: Seal lap joints with 100% coverage of vapour barrier adhesive. Seal butt joints with 50 mm wide strips of vapour barrier sealed with vapour barrier adhesive. For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells, seal all laps and joints.

.7 Flare out staples may be used to secure jacket laps on hot systems. Staples are to be applied on 100 mm centres.

.8 Hot Piping: For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells.

.9 Vents: Adhere flexible insulation with adhesive applied to all laps. Provide annealed tie wire at 400 mm centres for securing insulation. Butt insulation and seal joints and breaks with 50 mm of foil adhered over joint.

.10 Engine Exhaust: Tightly butt insulation with staggered joints secured with metal bands or wire. Cover fittings with equivalent thickness of insulation.

3.3 INSULATION INSTALLATION THICKNESS SCHEDULE

	Piping or Equipment	Pipe Sizes mm	Insulation Thickness mm	Recovery Jacket
1.	Domestic Cold Water Piping	15 to 25	12	Canvas
2.	Domestic Hot Water Supply Piping	15 to 50 Over 50	25 40	Canvas
3.	Vents within 3 m of Roof Outlet, as measured along pipe	All sizes	25	Canvas
4.	Glycol Heating Piping	All sizes	40	Canvas
5.	Engine Exhaust and Muffler	All sizes	100	Aluminum

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E202-12, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:

.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

.1 Pump operation.

.2 Boiler operation.

.3 Control pressure failure.

.4 Maximum heating demand.

.5 Boiler failure.

.6 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.3 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:

.1 TAB has been completed

.2 Verification of operating, limit, safety controls.

.3 Verification of primary and secondary pump flow rates.

.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.

.2 Test procedures:

.1 Open fully heat exchanger, heating coil and radiation control valves.

.2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

.3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

1.4 GLYCOL SYSTEMS

.1 Test to prove concentration will prevent freezing to minus 40 degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

1.5 FUEL OIL SYSTEMS

.1 Environmental protection systems:

.1 Test oil storage tank leakage detection system using manufacturer's recommended procedures.

.2 Test spill protection and over-fill protection systems using manufacturer's recommended procedures.

.2 Fuel oil pumps:

.1 Check strainers on pump inlet, relief valve on pump outlet with discharge to oil return piping, pressure gauge on strainer inlet, pump inlet and pump discharge.

.2 Verify pump performance.

.3 Pump performance within plus 20% and minus 0% of design.

.3 Operational Tests:

.1 Timing: perform at same time as 100% and 105% boiler PV tests.

.2 Charge system and verify operation.

.3 Verify adequacy of flow rates and pressure from storage facilities to burners.

.4 Verify accurate metering of fuel to burners.

.5 For further details refer to relevant sections of Division 23.

1.6 POTABLE WATER SYSTEMS

.1 When cleaning is completed and system filled:

.1 Verify performance of equipment and systems as specified elsewhere in Division 23.

.2 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 77 00 – Closeout Procedures.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME-B16.3-16, Malleable-Iron Threaded Fittings.

.2 ASME-B16.9-12, Factory-Made Wrought Steel Buttwelding Fittings.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A47/A47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM B61-15, Standard Specification for Steam or Valve Bronze Castings.

.4 ASTM B75/B75M-11, Standard Specification for Seamless Copper Tube.

.3 Canadian Standards Association (CSA International)

.1 CSA-B139-15, Installation Code for Oil Burning Equipment.

.2 CSA-B140.0-03(R2013), Oil Burning Equipment: General Requirements.

.4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)

.1 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Place materials defined as hazardous or toxic in designated containers.

.4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

Part 2 Products

2.1 ABOVEGROUND FUEL PIPING

.1 Steel: to ASTM A53/A53M, Schedule 40, continuous weld or electric resistance welded, screwed.

.2 All joints and connections shall be welded.

2.2 FLEXIBLE PIPING

.1 General

.1 Shall be of the same dimension as the piping, not the dimension of the connection to the equipment, with screwed joints on pipes of NPS 2 or less. Install where indicated. All external flexible piping to be at least 600mm in length.

.2 Piping NPS 2 and under:

.1 Flexible pipes made of brass mesh, screwed joints, designed to resist a minimum of 1035 kPa and resist fatigue stress of lateral movements of 13mm amplitude at 50 Hz.

2.3 STEEL PIPE COATING

.1 Bituminous paint: in accordance with manufacturer's recommendations.

2.4 JOINTING MATERIAL

.1 Screwed fittings: Teflon tape or pulverized lead paste.

.2 Soldered fittings: silver solder.

2.5 FITTINGS

.1 Steel:

.1 Malleable iron: screwed, banded, Class 150 to ASME-B16.3.

.2 Welding: butt-welding to ASME-B16.9.

.3 Unions: malleable iron, brass to iron, ground seat, screwed, to ASTM A47/A47M.

.4 Nipples: Schedule 40, to ASTM A53/A53M.

.2 Copper:

.1 Piping: soldered type.

.2 Connections to equipment: compression.

2.6 GATE VALVES

.1 NPS 2 and under, screwed bonnet:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body and trim.

.1 Steel Piping: Screwed joints.

.2 Copper piping: Soldered joints.

2.7 GLOBE VALVES

.1 NPS 3 and under, screwed:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body and trim, composition disc suitable for oil service, removable.

2.8 BALL VALVES

.1 NPS 2 and under:

.1 Bronze body, screwed ends, TFE seal, hard chrome ball, 4 MPa, WOG.

2.9 SWING CHECK VALVES

.1 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.

2.10 AUTOMATIC SHUT-OFF VALVE-SOLENOID

.1 Furnish and install a normally open solenoid valve at discharge side of pumps.

.1 Body: Brass

.2 Seals and Disc: Stainless Steel

.3 Core and Plugnut: 430F Stainless Steel

.4 Springs: 302 Stainless Steel

.5 Shading Coil: Copper

2.11 ANTI-SIPHON VALVE

.1 Furnish and install at the high point of the oil suction line a UL listed and labeled Anti-Siphon Valve. Valves that do not have an Underwriters Laboratory certification, listing and label shall not be acceptable. The valve shall automatically shut off the oil flow in the event of a broken or inadvertently left open oil suction line. In the event of a fire, to avoid thermal expansion induced valve failure the Anti-Siphon Valve body material must be bronze. Anti-Siphon Valves supplied with CAST IRON bodies or without a UL labels shall be removed and a UL certified bronze body valve will be installed at the contractor expense. The valve shall be sized to meet the flow and vertical pipe height requirements of the system.

2.12 FIRE VALVES

.1 Quick closing, spring loaded fire safety gas shut-off valve with fusible element which melts at 74º C allowing the valve to close tightly.

.2 Aluminum valve body and bonnet, zinc plated brass adapter, stainless steel stem.

.3 Maximum pressure differential: 34 kPa.

.4 Such as Model 939 by Morrison Bros. Co. or approved equivalent.

2.13 OIL-WATER SEPARATORS

.1 Die cast aluminum head and steel filter bowl assembly. Powder coated components with locking ring collar capable of operating at a design pressure of 1035 kPa. NPS 1 ½ inlet and outlet with a maximum flow rate of 1.58 L/s.

.2 Install with stop valves and pressure gauges on both sides.

.3 Provide spare filter cartridge.

2.14 OIL FILTER

.1 Duplex type replaceable cartridge type as recommended by oil burner manufacturer.

.2 Furnish spare filter cartridge.

2.15 OIL LEVEL INDICATOR

.1 Double float tank gauge, installs on 1½"-2" openings for a 1000 gallon tank with dip length up to 48", such as Golden Gallon Gauges.

2.16 TANK VENT WHISTLE

.1 Cast iron construction adaptor with aluminum whistle, such as Model E500-999 UA by AT&S.

2.17 AUTOMATIC FUEL OIL TRANSFER PUMP SET AND CONTROL CABINET FP-01, FP-02

.1 Supply two self-contained, duplex automatic fuel oil transfer and monitoring systems to ensure a reliable supply of fuel oil to the emergency generators. The system shall include automatic pump set lead/lag, storage tank and day tank level monitoring, leak monitoring, LCD operator display, manual back-up stations, time and date stamped alarm and event summary, and the system shall include the capability to simultaneously communicate to a Building Automation System (BAS). The control system shall be a microprocessor-based design with field expandable plug-in Input/Output modules.

.2 The automatic fuel oil transfer pump and straining set shall be two positive displacement self-priming, direct driven from motor, mounted on carbon steel stand. Complete with mechanical seal, permanently sealed ball bearings, relief valve, pressure gauge on discharge, 25 mm duplex strainer, check valves on discharge of each pump and flanges allowing easy assembling and easy removal.

.3 Capacities:

.1 FP-01,

.1 Pumped fluid: No. 2 diesel fuel.

.2 Flow rate: 60 usgph (227 L/min); 344 kPa of head.

.3 Motor: 1/3 hp, 120 V, 1 ph., 60Hz, 1150 r/min, explosion proof motor.

.2 FP-02

.1 Pumped fluid: No. 2 diesel fuel.

.2 Flow rate: 112 gph (424 L/min); 344 kPa of head.

.3 Motor: 1/3 hp, 120 V, 1 ph., 60Hz, 1150 r/min, explosion proof motor.

.4 Pump set and Control Cabinet

.1 The Pump Set and Control Cabinet shall be completely pre-wired and tested to ensure job site reliability. The pump set and control cabinet shall be the product of one manufacturer for single source responsibility. Provide a factory assembled steel enclosure with all operator interface control switches, indicators and displays physically separated from any field terminations. Manual Back-up control switches and indicators must be protected from unauthorized operation by a key lockable door with a viewing window.

.5 Control and Monitoring Hardware

.1 The control strategy shall be microprocessor-based. The controller shall be designed so that it will "fail safe" in the event there is a microprocessor failure. Control hardware shall include combination magnetic motor starters with overload protection and circuit breakers. Provide safety interlocks to shutdown both pumps during any of the following conditions: day tank "leak detected" and "high-high" day tank level. These interlocks must continue to ensure safe pump operation even if the controller has failed or is out of service and the pump set is operated in manual "hand" mode.

.6 Operator Interface

.1 The control system shall include a 16 line x 40 character or greater LCD display for pump set status, storage tank level indication, alarm listing, and trouble shooting functions. Provide a tactile feedback, numeric keypad for data entry. Provide dedicated pushbuttons for Alarm Silence and for the Home Page display and a "Hand-Off-Automatic" control switch for each fuel pump. In "Hand" position the pump shall be capable of manual operation in the event of a controller failure. The control system shall monitor the position of each "Hand-Off-Automatic" control switch. Should a switch be put into the "Off" position, the controller shall log the event with a Time/Date stamp and store within the controller memory. Provide an Elapsed Time Recorder (ETR) to measure running time for each pump. Provide a Fuel Oil Overview Display (Home Page) capable of simultaneous viewing of pump set status, day tank status and main storage tank status. The Fuel Oil Overview display shall include the following information:

.1 Lead Pump Selection – Auto/Manual
.2 Pump Status – Off/Run/Standby
.3 Day Tank Status – Normal/High/Low/Low-low
.4 Main Tank Status – Normal/High/Low/Low-low
.5 Three Most Recent Alarms

.7 Alarm and Event Logs

.1 The control system shall record and annunciate the following alarms:

.1 Pump Thermal Overload
.2 Pump Loss of Flow
.3 Pump Set Failure
.4 Day Tank High-High Level
.5 Day Tank High level
.6 Day Tank Low level.
.7 Day Tank Low-Low Level

.2 The control system shall record the following events:

.1 Pump Started
.2 Pump Control Switch in "Off" position

.3 Pump Set Prime Test OK

.4 Pump Selected as Lead.

.8 Day Tank Fuel Oil Supply Applications

.1 Provide automatic, microprocessor-based day tank level control. The lead fuel pump shall be energized when Day Tank oil level falls below 50%. The lead pump shall continue to operate until the day tank level is greater than 80%. Upon the next call for fuel, the lead pump shall be automatically alternated. The control system shall automatically energize the back-up pump upon detecting a low level condition (40% full condition). Both pumps shall then continue to operate until the level of oil reaches the high level point (90% full condition). Upon detection of loss of flow or lead pump thermal overload the control system shall automatically energize the backup pump and de-energize the lead pump.

.9 Automatic Pump Prime and Suction Line Integrity Check

.1 The control system shall include a battery backed, real time clock and must be capable of automatically energizing the lead pump once every day. This is to verify suction piping integrity and pump prime and verify pump operation. Once the lead pump has proven satisfactory operation, the lag pump shall be energized and run through the same test. These tests shall be recorded in the controller memory with a Time/Date stamp for later verification. If either lead or lag pump fails any of these tests, the control system shall generate an audible and visual alarm and log the "Failed Pump" condition.

.10 Main Storage Tank Monitoring

.1 The control system shall include main storage tank level sensor and discriminating leak sensor monitoring. Provide a continuous display of tank content, in both liters and mm of product, within the main storage tank. Tank alarm displays shall not interfere with the display of the tank content. Provide data recall of the instantaneous display of tank content at the time of leak alarm condition. The control system shall include an overfill alarm circuit test pushbutton to provide instantaneous proving of audible and visual alarm circuitry associated with instrument overfill alarm contact. The controller must be field expandable using plug-in input modules to monitor up to 2 storage tanks and 6 discriminating leak sensors. Provide all equipment capabilities specified in this paragraph even if a connecting level and leak sensors will not be used.

.11 Piping And Mounting

.1 Provide duplex pump and straining set that is factory assembled with components piped and mounted on a continuously welded steel plate containment basin with NPS 3 steel side rails. Provide a NPS ½ containment basin plugged drain connection. The basin shall be sized to contain potential leaks from all factory installed piping and components. Pipe shall be schedule 40 ASTM A-53 Grade "A" with ANSI B16.3 Class 150 malleable iron threaded fittings.

.12 Pump Isolation and Check Valves

.1 Provide and mount four (4) pump isolation valves. Locate one (1) valve on the suction and discharge side of each pump. Isolation valves will allow off-line pump maintenance without system loss of availability. Isolation valves shall be ball type valves to provide full flow while open and positive shutoff when closed. Additionally, two (2) check valves shall be provided and mounted, one (1) located on the discharge of each pump.

.13 Fuel Oil Strainer

.1 Provide and mount two (2) simplex strainers with 40 mesh baskets, one (1) located on the suction side of each pump.

.14 Relief Valves

.1 Provide and mount two (2) relief valves sized to relieve the full outlet flow of the pump without causing the pump motor to overload or any component's pressure rating to be exceeded if the discharge is inadvertently valved off. Relief valves must be externally mounted from the pumps and piped to the return line in the field according to NFPA 30. Pump internal relief valves shall not be accepted.

.15 Compound And Pressure Gauges

.1 Provide and mount a compound gauge on the suction side of the strainer. The gauge shall read –100 kPa vacuum. Provide and mount a pressure gauge on the discharge side of each pump. Each gauge shall be quipped with an isolation ball valve.

.16 Pump Automatic Sequencing Flow Switch

.1 Provide a time delayed flow sensing switch on the discharge of the pump set to bring on the lag pump should the lead pump fail to maintain flow. Flow switch shall be vane operated to actuate a single double throw snap switch. Switch shall be factory wired to the control cabinet for alarm and backup pump operation. Switch shall be rated for 10 Mpa. Provide a flow switch outlet isolation valve for maintaining the flow switch without draining the fuel system.

.17 Communications

.1 The pump set must include an optically isolated communications data highway. The protocol shall allow: Auto/Manual mode change, lead pump selection, sensing and silencing of alarms, change of any configuration parameter, change of timers, etc.

.2 Provide all equipment capabilities specified in this paragraph, even if a connecting BAS system is not included in this project. It must be possible to field upgrade the control system to "dial out" to an alphanumeric pager system via field installable plug-in option modules in the future.

.18 Quality Assurance

.1 The Control Cabinet shall be manufactured and labeled in accordance with CSA C22.2 #14. The assembled control cabinet, as a whole, must be inspected for proper wiring methods, fusing, etc., and must be labeled as conforming to CSA C22.2.

.19 Factory Testing

.1 Pump Sets must be fully tested prior to shipment. Testing shall include both a pressure and vacuum testing period. First, the complete pump set shall be pressure tested to rated pressure using an air pressure source. The test shall confirm that the pump set piping system can maintain rated pressure for 4 hours. Next, the complete pump set shall be brought to a vacuum greater than 85 kPa. The test shall confirm that the pump set piping system can maintain vacuum for 4 hours. Following a pressure and vacuum test the pump set shall be given a full operational test. The pump set shall be connected to a fuel oil supply and return. The pump set shall be operated normally. Motor amps shall be noted at no load and full load for each motor. The motor amps shall be within 10% of rated motor amps. During the test the relief valve shall be set and tested. Operation of pump set instrumentation shall be tested. A copy of the test procedures shall be sent to the Engineer.

.2 A certificate of factory testing, together with a copy of the wiring and arrangement diagrams shall be placed in the control cabinet prior to shipment.

.20 Duplex fuel oil systems and Control Panels, such as Model DUP-03G-BS by Albany Pumps.

2.18 ABOVE GROUND OUTDOOR OIL TANK

.1 Relocated from Existing Pumping Station

2.19 TEMPORARY OUTDOOR OIL TANK

.1 Provide and install a temporary tank to supply the existing pump station during the switch over period.

.1 Weld-free galvanized steel outer tank capable of holding 110% of the primary tank; double walled tank.

.2 Seamless high-density polyethylene inner tank.

.3 Corrosion resistant steel filling system with external 2” thread.

.4 ULC- S602 approved.

.5 Capacity 1000 liters, such as S602 Horizontal by Dejardins Industries.

2.20 OIL DAY TANKS

.1 Boiler Day tank

.1 Weld-free galvanized steel outer tank capable of holding 110% of the primary tank; double walled tank.

.2 Seamless high-density polyethylene inner tank.

.3 Corrosion resistant steel filling system with external 2” thread.

.4 ULC- S602 approved.

.5 Provide tank with foot valve on the supply line

.6 Ensure to supply tank with additional openings for future use.

.7 Capacity 896 liters, such as Model 602-RECT-DP by ATS.

.2 Generator Day tank

.1 Weld-free galvanized steel outer tank capable of holding 110% of the primary tank; double walled tank.

.2 Seamless high-density polyethylene inner tank.

.3 Corrosion resistant steel filling system with external 2” thread.

.4 ULC- S602 approved.

.5 Provide tank with foot valve on the supply line

.6 Ensure to supply tank with additional openings for future use.

.7 Capacity 459 liters, such as Model 602-RECT-DP by ATS.

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 datasheet.

3.2 PIPING

.1 Install oil-piping system in accordance with CSA-B139 and CSA-B140.0.

.2 Assemble piping using fittings to ANSI standards.

.3 Slope piping down in direction of storage tank unless otherwise indicated.

.4 Suction and return piping inside building:

.1 Steel, with screwed fittings.

.2 Install filter and gate valve as shown.

.5 Fill, vent outside building:

.1 Steel piping welded throughout except at tanks where use electrically isolating fittings.

.2 Grading: slope piping at 1 % minimum back to tanks.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless approved otherwise by Engineer.

3.4 OIL FILTERS

.1 Install as indicated.

.2 At time of acceptance, replace filter cartridge with new.

3.5 OIL TRANSFER PUMPS

.1 Install as indicated.

.2 Install gate valves on inlet and discharge connections.

.3 Install pressure gauge at pump discharge.

.4 Install relief valve in pump discharge piping with relief valve discharge pipe to return line to tank.

3.6 CLEANING

.1 Flush after pressure test with number 2 fuel oil for a minimum of two hours. Clean strainers and filters.

.2 Dispose of fuel oil used for flushing out in accordance with requirements of authority having jurisdiction.

.3 Check vents from regulators, control valves are terminated in approved location and are protected against blockage and damage.

.4 Entire installation shall be inspected and approved by authority having jurisdiction.

.5 Perform cleaning operations in accordance with manufacturer's recommendations.

.6 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This section describes the pipe materials, fittings, appurtenances, installation and testing of the plumbing and HVAC systems.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).

.1 ASME B31.1-14, Power Piping.

.2 ASME B16.25-2012, Buttwelding Ends, ASME Section IX.

.2 Canadian Standards Association (CSA International)

.1 CSA B139, Installation Code for Oil Burning Equipment (2015).

1.3 QUALITY ASSURANCE

.1 Welding materials, fabrication standards and labour qualifications must conform to ANSI/ASME B31.1, ANSI B 16.25, ASME Section IX, and the Provincial Board of Labour Regulations latest current editions.

.2 Use welders fully qualified and licensed by Provincial Authorities.

.3 Oil Piping: CSA Standard B 139, Installation Code for Oil Burning Equipment (latest edition).

.4 Domestic Water, Drainage and Vent Piping: current Provincial and Municipal Codes.

.5 All below grade steel piping shall be yellow jacketed with taped and sealed joints.

.6 Non-specified pipe joining and pipe fitting methods such as T-drill and press fit are not permitted in any piping system covered under Division 23.

.7 Conflicts:

.1 Review the Drawings prior to installation of piping, conduit services, and fixtures by this or any other division. Identify any conflicts and cooperate with the Engineer to determine the adjustments necessary to resolve these conflicts.

.2 Confirm the routing of each section of pipework with other services prior to commencement of installation. Advise the Engineer of any conflicts with existing services or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict and confirm with the Engineer.

Part 2 Products

2.1 PIPE

	Service	Material
.1	Domestic water, above ground (inside building)	Type 'L' hard copper
.2	Process Water	PVC Schedule 40

	Service	Material
.3	Oil (above ground)	Steel, Sch.40, ASTM Al20
.4	Diesel engine exhaust Grade B	Steel, Sch.40, ASTM A53, UL Listed Insulated Position Pressure Piping System
.5	Equipment drains and overflows	Sch.40, galvanised steel, ASTM Al20 Type 'L' hard copper ASTM B88M

2.2 FITTINGS AND JOINTS

	Service	Material	Joint
.1	Domestic water, above ground	Wrought copper, bronze Cast bronze	Lead free solder, brazed for pipes over 50 mm Screwed
.2		Banded malleable iron 1033 kPa, up to 50 mm	Screwed
.3	Oil (above ground)	Malleable iron, banded, 1033 kPa Forged steel Forged steel, socket weld Steel, same schedule as pipe Cast bronze	Screwed Screwed Welded Welded Flared tube
.4	Diesel engine exhaust Grade B	Steel, same schedule as pipe, all sizes	Welded
.5	Equipment drains and overflows	Galvanised banded malleable iron, Wrought copper, bronze Cast brass	Screwed 50-50 solder Screwed

.7 Use factory fabricated butt welded fittings for welded steel pipes.

.8 Use long radius elbows for steel and cast iron water piping, including grooved mechanical fittings.

.9 Where not shown or otherwise specified, use solvent weld joints for PVC piping. Minimize number of threaded joints on all PVC piping.

2.3 UNIONS, FLANGES AND COUPLINGS

.1 Size 50 mm and under: 1033 kPa malleable iron, bronze to iron ground joint unions for threaded ferrous piping, air tested for gas service, all bronze for copper piping.

.2 Sizes 65 mm and over: 1033 kPa forged steel welding neck flanges for ferrous piping, 1033 kPa bronze slip-on flanges for copper piping. Gaskets shall be 1.5 mm thick performed synthetic rubber bonded asbestos. Gaskets for gas service shall be synthetic rubber.

.3 Flange bolting: For systems up to 120°C, use carbon steel stud bolts, semi-flushed and heavy hex nuts, ASTM A307-GrB. For systems up to 215°C, use alloy steel bolts ASTM A193-GrB7, and semi-finished heavy hex nuts ASTM A194-Gr2H.

.4 Where permitted by the Engineer, use grooved mechanical couplings to engage and lock grooved or shouldered pipe ends and to allow for some angular deflection, contraction and expansion. Couplings consist of malleable iron housing-clamps, C-shaped composition sealing gasket EPDM Grade 'E' and steel bolts. Use galvanised couplings for galvanised pipe. Victaulic brand or Grinnel Gruv-Lok only.

Part 3 Execution

3.1 PREPARATION

.1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

3.2 PIPE HANDLING

.1 Inspect each pipe and fitting prior to installation. Do not install damaged pipe or pipe with damaged protective coatings.

.2 Remove all foreign matter from inside of pipe prior to installation.

.3 Repair pipe with damaged protective coatings with material similar to the original in accordance with the manufacturer's directions and to the satisfaction of the Engineer.

.4 Use proper implements, tools, and facilities for the proper protection of the pipe. Exercise care in the installation so as to avoid damage to pipe or coatings.

3.3 CONNECTION

.1 Screw joint steel piping up to and including 40 mm Weld piping 65 mm and larger, including branch connections. Screw or weld 50 mm piping for liquid systems.

.2 Make screwed joints with full cut standard taper pipe threads with approved non-toxic joint compound applied to male threads only.

.3 Make joints for plain end pipe with gasket and clamp type mechanical fastener.

.4 Use grooved mechanical couplings and mechanical fasteners, only where permitted by the Engineer.

.5 Use galvanised couplings with galvanised pipe.

.6 Make connections to equipment, specialty components, and branch mains with unions or flanges.

.7 Provide dielectric type connections wherever joining dissimilar metals in open systems. Brass adapters and valves are acceptable.

.8 Use insulating plastic spacers for copper pipe installation in metal studs.

3.4 ROUTE AND GRADES

.1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furring to a minimum.

.2 Slope water piping 0.2% and provide hose bibb drains at low points.

.3 Equip low points with 20 mm drain valves and hose nipples.

.4 Provide air collection chambers with manual air vent at all high points of system. Collection chambers to be 25 mm dia. or line size whichever is greater and 150 mm high minimum. Square tees may only be used to assist with complete venting and draining.

.5 Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting. Top flat for water.

.6 Grade horizontal drainage and vent piping 2% minimum, unless noted otherwise.

.7 Pipe the discharge from all relief valves, safety valves, vents, drains, water columns and overflows to the nearest building drain. Pipe to glycol recovery tanks for a glycol based system.

3.5 INSTALLATION

.1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.

.2 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code 2013.

.2 ASTM International Inc.

.1 ASTM A47/A47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-01(2015), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M-10(2015), Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84(2014), Standard Specification for Ductile Iron Castings.

.5 ASTM B62-15, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International)

.1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

Part 2 Products

2.1 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 690 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS ½ connection and rated at 860 kPa working pressure.

.3 Float: solid material suitable for 115ºC working temperature.

2.2 COMBINATION SEPARATORS/STRAINERS

.1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.3 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

.1 Adjustable pressure setting: 206kPa relief, 55 to 172kPa reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.4 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, solder end or screwed connections, Y pattern.

.2 NPS 2 1/2 to 12: cast steel body to ASTM A278/A278M, Class 30, cast iron body to ASTM A278/A278M, Class 30 flanged connections.

.3 NPS 2 to 12: T type with ductile iron body to ASTM A536 for malleable iron body to ASTM A47M, grooved ends.

.4 Blowdown connection: NPS 1.

.5 Screen: stainless steel or brass with 1.19mm perforations.

.6 Working pressure: 860kPa.

Part 3 Execution

3.1 GENERAL

.1 Install as indicated and to manufacturer’s recommendations.

.2 Run drain lines and blow off connections to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request and follow Engineer's directive.

.5 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.2 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

.4 Install ahead of each automatic control valve larger than NPS 1 and radiation and as indicated.

3.3 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink

3.4 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 23 05 93 – Testing, Adjusting and Balancing (TAB) of Mechanical Systems.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).

.1 ANSI/ASME B16.1-2015, Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, 250 and 800.

.2 ANSI/ASME B16.3-2011, Malleable-Iron Threaded Fittings, Classes 150 and 300.

.3 ANSI/ASME B16.5-2013, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.

.4 ANSI/ASME B16.9-2012, Factory-Made Wrought Steel Butt-welding Fittings.

.5 ANSI B18.2.1-2012, Square Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).

.6 ANSI/ASME B18.2.2-2015, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.2 American National Standards Institute (ANSI)/American Water Works Association (AWWA).

.1 ANSI/AWWA C111/A21.11-12, Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

.3 American Society for Testing and Materials International, (ASTM)

.1 ASTM A47/A47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM A536-84(2014), Standard Specification for Ductile Iron Castings.

.4 ASTM B61-15, Specification for Steam or Valve Bronze Castings.

.5 ASTM B62-15, Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM E202-12, Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.4 Canadian Standards Association (CSA International)

.1 CSA B242-05(R2016), Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel Structures.

.5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.1 MSS-SP-67-2011, Butterfly Valves.

.2 MSS-SP-70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71-2011, Cast Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.

.5 MSS-SP-85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate on manufacturer's catalogue literature the following: valves.

.3 During the shop drawing submittal stage, the Contractor is to supply a balance valve schedule indicating valve selection matched to required flows. Maximum pressure drop across fully open valve to be 15 kPa (5 ft).

1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedures.

1.5 SPARE PARTS

.1 Furnish following spare parts:

.1 Valve seats: one (1) for every ten (10) valves, each size. Minimum one (1).

.2 Discs: one (1) for every ten (10) valves, each size. Minimum one (1).

.3 Stem packing: one (1) for every ten (10) valves, each size. Minimum one (1).

.4 Gaskets for flanges: one (1) for every ten (10) flanges.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Collect, separate and recycle waste materials.

.2 Deposit metal, plastic, paper packaging and corrugated cardboard in appropriate on-site recycling bins.

.3 Deposit scrap wood products, including pallets and other wood used for shipping, on site in area designated. Remove all nails, staples, screws and other metal fasteners before depositing in designated area. Deposit metal fasteners with metals.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53, Grade B, as follows:

.1 To 150 mm (NPS 6), Schedule 40.

2.2 PIPE JOINTS

.1 50 mm (NPS 2) and under: screwed fittings with Teflon tape.

.2 65 mm (NPS 2-1/2) and over: welding fittings and flanges to CSA W47.1 and CSA W47.1S1 or roll grooved couplings with angle bolt pads to ASTM A-536. All grooved material to be from a single manufacturer.

.3 Flanges: plain or raised face, slip-on weld neck.

.4 Orifice flanges: slip-on raised face, 2100 kPa (305 psi).

.5 Flange gaskets: to ANSI/AWWA C111/A21.11.

.6 Pipe thread: taper.

.7 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.

.2 Butt-welding fittings: steel, to ANSI/ASME B16.9.

.3 Pipe flanges and flanged fittings:

.1 Cast iron: to ANSI/ASME B16.1, Class 125.

.2 Steel: to ANSI/ASME B16.5.

.4 Roll-grooved mechanical pipe couplings, fittings, valves and other grooved components may be used as an alternative to welding, threading or flanged methods. All grooved products shall be of one manufacturer.

.1 Acceptable Material:

.1 Rigid Type: Victaulic Style 107 QuickVic Coupling for 50-200 mm (2-8@), Style 07 for 250-300 mm (10-12@) and AGS Style W07 for 350 mm (14@) and above.

.2 Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three (3) couplings for each connector shall be placed in close proximity to the vibration source. Acceptable Material: Victaulic Style 177 for 50-200 mm (2-8@), Style 77 for 250-300 mm (10-12@) and AGS Style W77 for 350 mm (14@) and above.

.5 Unions: malleable iron, to ASTM A47M and ANSI/ASME B16.3.

2.4 GATE VALVES

.1 50 mm (NPS 2) and under, screwed:

.1 Rising stem: to MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, solid wedge disc.

.2 Acceptable material: Crane 428, Jenkins 810, Toyo 293, Kitz #24, Nibco.

.2 65 mm (NPS 2-1/2) and over in mechanical rooms, flanged:

.1 Rising stem: to MSS SP-70, Class 125, 860 kPa (125 psi), full faced flanges, cast-iron body, OS & Y bronze trim.

.2 Acceptable material: Crane 4652, Jenkins 454J, Milwaukee F-2885, Kitz #72, Nibco.

.1 65 mm (NPS 2-1/2) and over, grooved:

.1 For grooved and piping, butterfly valves may be used in lieu of gate valves.

.2 Standard of Acceptance: Victaulic VIC 300 Masterseal Butterfly Valve.

2.5 BALL VALVES

.1 50 mm (NPS 2) and under, screwed:

.1 Class 150.

.2 Bronze two-piece body, chrome plated brass or stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle.

.3 Acceptable material: Crane 9202, Jenkins 901BJ, Milwaukee BA-100, Watts B-6000-01, Kitz #58, Nibco.

.2 50 mm (NPS 2) and under, soldered:

.1 To ANSI B16.18, Class 150.

.2 Bronze two-piece body, chrome plated brass or stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle, with NPT to copper adaptors.

.3 Acceptable material: Crane 9222, Jenkins 902B, Milwaukee BA-150, Watts B-6001-01, Kitz #59, Nibco.

2.6 GLOBE VALVES

.1 50 mm (NPS 2) and under, screwed:

.1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, screwed over bonnet, stainless steel disc.

.2 Acceptable material: Crane 142 P, Jenkins 2032, Toyo 214, Kitz #17, Nibco.

.2 65 mm (NPS 2-1/2) and over, flanged:

.1 To MSS SP-85, Class 125, 860 kPa (125 psi), full faced flanges, cast iron body, bronze trim, OS&Y, bolted bonnet, bronze disc and seat ring.

.2 Acceptable material: Crane 351, Jenkins 2342, Toyo 400A, Kitz #76, Nibco.

BUTTERFLY VALVES

.3 62 mm (NPS 2½) and over:

.1 to MSS-SP-67

.1 lug type.

.2 Body: ASTM A-536 Ductile Iron

.3 Bushing: Bronze outer shell inner lining bonded to fiberglass.

.4 Disc: ASTM A-351 316 Stainless Steel

.5 Shaft: 416 Stainless Steel

.6 Such as Watts BF-03-M2 Full Lug or approved equivalent.

2.7 SWING CHECK VALVES

.1 50 mm (NPS 2) and under, screwed:

.1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, bronze swing disc, screw in cap, regrindable seat.

.2 Acceptable material: Crane 37, Jenkins 4092, Toyo 236, Kitz #22, Nibco.

.2 50 mm (NPS 2) and under, soldered:

.1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, bronze swing disc, screw in cap, regrindable seat.

.2 Acceptable material: Crane 1342, Jenkins 4093J, Milwaukee 1509-T, Kitz #23, Nibco.

.3 65 mm (NPS 22) and up, flanged:

.1 To MSS SP-71, Class 125, 860 kPa (125 psi), cast iron body, full faced flange, renewable seat, bronze disc, bolted cap.

.2 Acceptable material: Crane 373, Jenkins 587J, Milwaukee F-2974, Kitz #78, Nibco.

2.8 CIRCUIT BALANCING VALVES

.1 General:

.1 Y-style globe valve, designed to provide precise flow measurement and control, with valved ports for connecting to differential pressure meter.

.2 Accuracy:

.1 Readout to be within ±2% of actual flow at design flow rate.

.3 50 mm (NPS 2) and under:

.1 Bronze or brass copper alloy (Ametal) construction; maximum WP: 1700 kPa (246 psi); Max temp: 121☜C (250☜F), screwed ends, Teflon disc, screwed in bonnet.

.2 Flow control: at least four (4) full turns of handwheel with digital hand wheel and tamperproof concealed mechanical memory.

.3 For flows less than 3.8 L/min (1 gal/min), use a reduced flow type unit.

.4 65 mm (NPS 2-1/2) and over:

.1 Cast iron construction: bonnet and trim of bronze or brass copper alloy (Ametal); bonnet bolts of stainless steel maximum WP: 1700 kPa (246 psi); Maximum temp: 121☜C (250☜F); ANSI Class 125 flanged ends.

.2 Flow control: at least eight (8) full turns of handwheel with Vernier type ring settings and tamperproof concealed mechanical memory.

.5 Insulation: use prefabricated shipping packaging of 5.4 R polyurethane as insulation for installation.

.6 Drain connection:

.1 20 mm (NPS ¾) valved and capped drain connection suitable for hose socket to be incorporated into the valve body or provided as separate item.

.7 Standard of Acceptance: Tour & Andersson type 786/787 STAD and 788/789 STAG. Victaulic Koil-kits may also be used for coil connections. B&G Circuit Setter Type "RF" for low flow applications and B&G Circuit Setter elsewhere, Armstrong, Danfoss.

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.

.7 Assemble piping using fittings manufactured to ANSI standards.

.8 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

.9 Provide allowance for thermal expansion and contraction.

3.2 VALVES

.1 Install valves with stems upright or horizontal unless approved otherwise by the Engineer.

.2 Install gate or ball valves at all branch take-offs and to isolate each piece of equipment, and as indicated.

.3 Install globe valves in by-pass around control valves as indicated.

.4 Provide silent check valves on discharge of pumps in vertical pipes with downward flow.

.5 Provide swing check valves in horizontal lines on discharge of pumps and as indicated.

.6 Install butterfly valves on piping NPS 2½ and higher

3.3 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and TAB is complete to satisfaction of Engineer.

3.4 VALVED VENTS

.1 Locations:

.1 At high points.

.2 Elsewhere as indicated.

.2 Discharge:

.1 Provide hose adaptor on valves where discharge piping cannot conveniently be carried to floor drains.

.3 Check operation after system is in use and under full pressure.

3.5 THERMOWELLS

.1 Install thermowells for sensors in locations indicated or as otherwise directed by the controls division.

3.6 COLD SPRINGING

.1 Cold springing is not required. Do not force pipes into position.

3.7 FLUSHING AND CLEANING

.1 Flush and clean in presence of Engineer.

.2 Flush after pressure test for a minimum of 4 h.

.3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 h.

.4 Drain and flush for 4 h. Remove strainer screen/basket and clean.

.5 Refill system with clean water and circulate minimum 2 h.

.6 Drain and flush for 2 h. Remove strainer screen/basket and clean. Re-install after obtaining Engineer’s approval.

.7 Vent piping systems thoroughly during all fillings.

3.8 BALANCING

.1 Refer to Section 23 05 93 - Testing Adjusting and Balancing (TAB) of Mechanical Systems.

3.9 COMMISSIONING

.1 Provide three (3) days written notice to Engineer of intention to start up, test and adjust.

.2 Underground heating line manufacturer's field engineer to provide instruction for product unloading, field jointing, pipe anchoring and testing.

.3 Start up systems only after written approval of installation from Engineer.

3.10 START-UP

.1 Provide continuous supervision during start-up.

.2 Start up systems only after written approval of installation from Engineer.

.3 Upon start-up, bring all mains up to temperature and pressure slowly over an 8 h period.

.4 After system is in operation and under maximum temperatures and pressures.

.1 Tighten all bolts on flanges, using torque wrench. Repeat several times during commissioning.

.2 Check operation of valves.

.5 Pipe supports:

.1 Monitor at all times during start-up and commissioning to ensure intended operation.

.2 Adjust pipe supports, hangers.

.6 Expansion joints:

.1 During warm-up, monitor carefully to ensure complete freedom of movement. If binding occurs, shut down system, re-align and repeat start-up procedures.

.7 Full scale tests:

.1 Upon completion, conduct full scale tests at maximum design flow rates, operating temperatures and pressures for continuous consecutive period of 48 h to demonstrate full compliance with design requirements.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Glycol mixing/charging tank, fill pump.

.2 Propylene glycol solution.

.3 Manual air vents.

.4 Relief valves and fittings.

.5 Accessories and connection to piping system.

.6 Expansion tanks.

.7 Air separator.

.8 Provide shop drawings for all scheduled tanks.

1.2 QUALITY ASSURANCE

.1 Thoroughly check system and make necessary corrections if system continually loses solution.

.2 Perform tests determining strength of glycol solution before system is turned over to the Owner. Provide test prior to end of guarantee and replenish as required. Provide written test results for review.

1.3 SUBMITTALS

.1 Provide shop drawings for all equipment in this section.

.2 Shop drawings shall include dimensions, materials of construction and performance data to match specifications.

Part 2 Products

2.1 GLYCOL SOLUTION

.1 Provide propylene glycol/water solution suitable for a temperature range of -40°C to 104°C (50%). Solution to be suitable for heating or cooling complete with appropriate corrosion inhibitors. Solutions must be factory premixed. Dowfrost HD.

2.2 GLYCOL MIXING CHARGING TANK, AND FILL PUMP

.1 System shall include 180 litre polyethylene storage/mixing tank with cover, pump suction hose with inlet strainer, pressure pump with thermal cut-out, integral pressure switch, integral check valve, cord and plug, pre-charged accumulator tank with EPDM diaphragm, manual diverter valve for purging air and agitating contents of storage tank, adjustable pressure regulating valve (35 – 380 kPa) complete with pressure gauge, integral replaceable strainer, check valve, union connection, 12 mm x 900 mm long flexible connection hose with check valve, low level pump cut-out.

2.3 MANUAL AIR VENTS

.1 Provide manual air vents with 25 mm or line diameter pipe whichever is greater to form air collection chamber. Collection chamber to be 150 mm high. Install manual air vents at high points in the system.

2.4 AIR SEPARATOR

.1 Air and dirt removal device shall be constructed of steel. It shall be designed, fabricated and stamped per ASME Section VIII Division 1 with a maximum working pressure of 125 psi at 270°F. Manufacturer shall be holder of ASME U stamp. Manufacturer to have optional 250 psi and 150 psi ASME units available.

.2 Units up to three 3-inch in size shall be provided with threaded connections as standard. Units four 4-inch and larger shall be provided with flanged system connections as standard. Inlet and outlet connections to be in line with piping system. Both inlet and outlet to be in the same horizontal and vertical planes.

.3 Each air and dirt removal device shall be equipped with a brass conical shaped air venting chamber designed to minimize system fluid from fouling the venting assembly. The air vent shall be able to be closed to allow flushing and purging of dirt via side port without dirt passing through vent on initial system fill.

.4 A brass flushing cock shall be located on the side of each separator to facilitate system fast-fill and removal of the floating impurities from the air system interface within the separator.

.5 A blow down valve shall be provided by the unit manufacturer on the bottom of each unit to allow blow down and cleaning. On units 2 ½" and smaller the valve and all of its fittings shall be 1". On units three 3" and larger the valve and all openings shall be 2".

.6 The air and dirt removal device shall remove air down to 18 microns and shall remove dirt/debris down to 35 microns. The unit shall be 100% efficient at removing dirt down to 90 microns in 100 passes or less.

.7 The air and dirt separator shall employ the use of high surface area pall rings to achieve optimal separation of air and dirt with minimal pressure drop. The pall rings shall be made of stainless steel. Stainless steel will be the only acceptable material used for suppressing turbulence and increasing surface area for high efficiency air and dirt removal. Inferior materials of construction such as copper for the straining medium will not be acceptable.

.8 Such as Model 4904H by Tyco, or approved equivalent.

2.5 RELIEF VALVES

.1 Provide ASME rated direct spring loaded type, lever operated non-adjustable factory set discharge pressure as indicated.

2.11 EXPANSION TANKS, DIAPHRAGM TYPE

.1 Welded steel, rated for working pressure, supplied with steel support structure.

.2 Precharged air chamber, heavy duty butyl diaphragm bonded with polypropylene liner to steel sheel separating air chamber from water.

.3 Such as Bell and Gosset model B-300 or approved equivalent.

2.12 HEAT EXCHANGER

1. Constructed of corrugated metal plates assembled in a frame and bolted between two pressure plates (one fixed and one adjustable.) Optimized for best water-to-water heat transfer providing enhanced performance especially in HVAC applications.

2. Materials:

   .1 Frames and pressure plates: stainless steel, painted carbon steel

   .2 Bolts: stainless steel, zinc-coated carbon steel

   .3 Support column: stainless steel

   .4 Plates: stainless steel

   .5 Gaskets: elastomer materials, sigma coat, compressed fibers (non-asbestos)

3. Dimensions: 787.4x355x676mm

4. Capacity: 1,380,000.0 BTU/hr

   .1 Hot Side (propylene glycol 50%)

   EWT: 93.3 °C

   LWT: 82.2 °C

   Flow rate: 9.62 L/s

   .2 Cold Side (water

   EWT: 1 °C

   LWT: 8.2 °C

   Flow rate: 12.6 L/s

5. Such as Armstrong model S-X13D-500-46 or approved equivalent.

Part 3 Execution

3.1 INSTALLATION

.1 Support coil sections on steel channel or double angle frames and secure to casings. Arrange supports for cooling coils so they do not pierce or short circuit drip pans. Level serpentine coils and install drainable tube coils with pitch within casing. Arrange galvanised steel casings for bolting to other section, ductwork or unit casings. Provide airtight seal between coils and duct or unit cabinets.

.2 Make necessary connections to coils, including valves, air vents, unions and connections from drip pans. Provide isolating valve on supply line and eccentric plug valve on return line to each glycol coil.

.3 Locate glycol supply at bottom of supply header and return glycol connection at top to provide self-venting and reverse return arrangement. Provide manual air vents at high points complete with stop valves. Ensure glycol coils are drainable and provide drain connection at low points.

.4 Protect coils so fins and flanges are not damaged. Replace loose and damaged fins. Comb out bent fins unless required to be replaced.

3.3 AIR VENTS

.1 Provide manual type at system high points and convection type heating units.

.2 Where large air quantities can accumulate, provide enlarged air collection standpipe.

3.4 AIR SEPARATOR

.1 Provide as shown on drawings.

3.5 RELIEF VALVE

.1 Provide relief valves on pressure tanks, low pressure side of reducing valves, heating convertors, expansion tanks and where indicated.

.2 Drain relief valve to glycol collection tanks. Do not waste glycol to floor drains.

.3 System relief valve capacity shall equal make-up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment.

.4 Where one line vents several relief valves, cross sectional areas shall exceed sum of individual vent areas.

3.6 GLYCOL MIXING CHARGINGTANK AND FILL PUMP

.1 Provide one tank and one pump.

3.7 EXPANSION TANKS

.1 Provide air lines, checks, charging valves and pressure gauges for expansion tanks and glycol fill tanks.

3.9 INSTALLATION

.1 Do necessary piping to complete installation as shown on the drawings specified.

.2 Thoroughly clean and flush system before antifreeze solution is added.

.3 Manually feed glycol to system through make-up line with pressure regulator.

.4 Provide one extra 170 L drum of glycol, at turn over of the building to owner.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

.3 Submit product data of pump curves for review showing point of operation.

.4 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

1.3 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Collect, separate and recycle waste materials.

.2 Deposit metal, plastic, paper packaging and corrugated cardboard in appropriate on-site recycling bins.

.3 Deposit scrap wood products, including pallets and other wood used for shipping, on site in area designated. Remove all nails, staples, screws and other metal fasteners before depositing in designated area. Deposit metal fasteners with metals.

Part 2 Products

2.1 LAKE SUBMERGED PUMPS (WP-01, WP-02, WP-03)

.1 Submersible turbine pump, premium ductile iron casting, spiral cutlass rubber intermediate bearings designed for harsh environments, 416 stainless steel pump shaft ground and polished for maximum durability, investment cast stainless steel impellors. The integrated pump check valves are to be removed at the plant. Pump to be supplied with variable frequency drive able to supply the flow at 100% and 30% depending on demand.

.2 Capacity:

Flow: 95.1 gpm (6 l/s.)

Head: 230 ft. H_2O (100 psi).

.3 Motor:

Sand fighter submersible motor with subtrol.

Stainless steel shell and cast iron epoxy coated end frames.

10 HP, 600/3/60

Dimensions: 6” diameter

.4 Model 6STS-100-6 by Franklin Electric.

2.2 IN-LINE CIRCULATORS

.1 Contractor shall furnish and install new split coupled vertical inline pump for chilled water and hot water heating systems as indicated on the drawings. Pumps shall be Series e-80SC as manufactured by Bell & Gossett under base bid. Equivalent units as manufactured by other manufacturers may be submitted as deduct alternates. Pumps shall meet types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule drawings. Pump substitutions shall be provided with connection sizes equal to those scheduled. Pump connections shall not be downsized. Pump substitutions shall not be provided at efficiencies less than those scheduled.

.2 COMPONENTS

.1 The pumps shall be a split-coupled, inline for vertical installation, in cast iron stainless steel fitted construction specifically designed for quiet operation. Suitable standard operations at 250° F and 175 PSIG working pressure. Working pressures shall not be de-rated at temperatures up to 250°F. The pump internals shall be capable of being serviced without disturbing piping connections.

.2 The pumps shall have a solid steel shaft that is guided by a carbon graphite lower throttle bushing.

.3 Pump shall be equipped with a Unitized inside mechanical seal assembly with flush line. The seal assembly shall have an EPR elastomer bellows and a positive metal-to-metal drive system to reduce torsional stress on the bellows. The bellows will be pressure supported without creases or folds for long life. The mechanical seal shall have a rotating carbon face against a stationary ceramic face.

.4 Pump shaft shall connect to a stainless steel impeller. Impeller shall be hydraulically and dynamically balanced to Hydraulic Institute Standards ANSI/HI 9.6.4.5-2000. The allowable residual imbalance conforms to ANSI grade 6.3, keyed to the shaft and secured by a stainless steel locking capscrew or nut.

.5 The pump shall include a spacer coupling of high tensile aluminum, split to allow the servicing of the mechanical seal without disturbing the pump or motor. Coupling shall incorporate tapered washer shaft jacking design.

.6 The combination motor bracket and volute coverplate shall be a one-piece unit to ensure concentric alignment of the motor to the pump casing. A carbon steel coupler guard conforming to both ANSI B15.1-2000 and OSHA 1910.219 standards shall be mounted on the motor bracket for safety.

.7 Pump volute shall be of a Class 30 cast iron design for heating systems rated for 175 PSIG with integral cast iron flanges drilled for 125# ANSI companion flanges. Volute shall include gauge ports at nozzles, and vent and drain ports. The volute shall be designed with a base ring matching an ANSI 125# flange that can be used for pump support.

.8 Motors shall be NEMA Premium efficient and shall be the size, voltage, and enclosure called for on the plans. Motors shall have heavy-duty grease lubricated ball bearings, completely adequate for the maximum load for which the pump is designed.

.9 Pumps shall conform to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.

.10 Pump shall be of a maintainable design and for ease of maintenance should use machine fit parts and not press fit components.

.11 Pump manufacturer shall be ISO-9001 certified.

.12 Each pump shall be factory tested and name-plated before shipment.

.3 INTEGRATED VFD WITH SENSORLESS PUMP CONTROL

.1 Integrated Pump Controller shall be factory mounted, wired, with a mains disconnect switch and menu-driven graphical interface.

.2 Integrated Pump Controller shall provide near unity displacement power factor (cos Ø) without need for external power factor correction capacitors at all loads and speeds using VVC-PWM type integrated controls.

.3 Integrated Pump Controller shall include dual DC link reactors equivalent to 5% impedance line reactors, for reduction of mains borne harmonic currents and DC link ripple current to increase DC link capacitor lifetime.

.4 Integrated Pump Controller shall have EMI/RFI filters conforming to DIN EN61800-3 to ensure integrated controls meets low emission and immunity requirements.

.5 System pressure to be maintained: 48 feet head minimum.

.6 Integrated Pump Controller shall support direct communication with the building management system (BMS) with built-in support for the following protocols: BACnet™ MS/TP.

.7 Integrated Pump Controller shall be provided in an Enclosure rated to UL Type 12 suitable for indoor operation.

.8 Integrated Pump Controller shall support Programmable skip Frequencies and adjustable switching frequency for noise and vibration control.

.9 Integrated Pump Controller shall provide a temperature controlled Fan for cooling of the heat sink in the back panel.

.10 Integrated Pump Controller shall be rated to operate in ambient working conditions of 14°F to +113°F, up to 3300 feet above sea level.

.11 Integrated Pump Controller shall provide 2 Analog inputs (current or voltage) and 1 current output.

.12 Integrated Pump Controller shall provide 6 programmable Digital inputs with 2 configurable as outputs.

.13 Integrated Pump Controller shall support 2 programmable pulse inputs

.14 Integrated Pump Controller shall provide 2 programmable relay outputs

.15 Integrated Pump Controller shall provide 1 RS485 communication port

.16 Integrated Pump Controller system software shall be capable of sensorless control in variable volume systems without need for pump mounted (internal/external) or remotely mounted differential pressure sensor.

.17 Integrated Pump Controller Sensorless control shall operate under Quadratic Pressure Control (QPC) to ensure head reduction with reducing flow conforms to quadratic control curve.

.18 Integrated Pump Controller shall support a minimum head of 40% of design duty head.

.19 Integrated Pump Controller shall provide user adjustable control mode settings and minimum/maximum head set points using built-in programming interface.

.20 Integrated Pump Controller integrated control software shall be capable of controlling pump performance for non-overloading power at every point of operation.

Integrated Pump Controller integrated control software shall be capable of maintaining flow rate data, standby/duty operation, and manage start stop of pumps in the case of failure.

.4 CHARACTERISTICS:

.1 Flow: 11.99 L/s (190gpm)

.2 Pressure: 143.5kPa (48ft of head)

.3 Such as Bell and Gossett model E-80SC 3x3x9.5C or approved equivalent.

Part 3 Execution

3.1 INSTALLATION

.1 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.

.2 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.3 Pipe drain tapping to drain.

.4 Install volute venting pet cock in accessible location.

.5 Check rotation prior to start-up.

.6 Install pressure gauge test cocks.

3.2 START-UP

.1 General:

.1 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system, over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Run-in pumps for 12 continuous hours.

.5 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.6 Eliminate air from scroll casing.

.7 Adjust water flow rate through water-cooled bearings.

.8 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.9 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.10 Eliminate cavitation, flashing and air entrainment.

.11 Adjust pump shaft seals, stuffing boxes, glands.

.12 Measure pressure drop across strainer when clean and with flow rates as finally set.

.13 Replace seals if pump used to degrease system or if pump used for temporary heat.

.14 Verify lubricating oil levels.

3.3 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning Requirements, supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

.2 Exclusions:

.1 This paragraph does not apply to small in-line circulators.

.3 Assumptions - these PV procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.4 Net Positive Suction Head (NPSH):

.1 Application: Measure NPSH for pumps which operate on open systems and with water at elevated temperatures.

.2 Measure using procedures prescribed in the Standard.

.5 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.1 Pump performance curves (family of curves).

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 23 33 00 – Air Duct Accessories

1.2 SCOPE

.1 Ductwork and plenums.

.2 Fasteners.

.3 Sealants.

.4 Duct cleaning.

1.3 DEFINITIONS

.1 Low Pressure: Static pressure in duct less than 500 Pa and velocities less than 10 m/s.

.2 Duct sizes shown on plans are inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

1.4 REFERENCES

.1 National Fire Protection Association (NFPA)

.1 NFPA (Fire) 90A, Installation of Air-Conditioning and Ventilating Systems, 2015 Edition.

.2 NFPA (Fire) 90B, Installation of Warm Air Heating and Air-Conditioning Systems. 2015 Edition

.2 Underwriters' Laboratories Inc. (UL)

.1 UL 181-2013, Factory-Made Air Ducts and Air Connectors

1.5 QUALITY ASSURANCE

.1 Ductwork shall meet the requirements of NFPA No. 90A - Air Conditioning and Ventilating Systems; NFPA No. 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.2 Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks.

.3 Flexible air duct shall conform to NFPA 90A and UL181 standard for factory made air duct materials and air duct connectors.

1.6 SUBMITTALS

.1 Submit shop drawings and samples of duct fittings for approval, including particulars such as gauge sizes, welds and configurations prior to start of work.

1.7 ALTERNATIVES

.1 Obtain written permission from the Engineer prior to making variations in duct configuration or sizes. Size alternatives using ASHRAE table for circular equivalents of rectangular ducts.

Part 2 Products

2.1 MATERIALS

.1 Ducts: Galvanised steel lock forming quality, having galvanised coating of 380 g/m^2 for both sides.

.2 Aluminum ductwork for Pump House and Wet Well areas.

.3 Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts. Weld kitchen exhaust ducts.

.4 Sealant: Water resistant, fire resistive, compatible with mating materials.

.5 Flexible Duct - Low Pressure: Flexible air duct shall be used where shown on drawings. Length of flexible duct shall not exceed 900 mm. Flexible duct shall be polymetric liner banded to a steel wire helix, wrapped with fiberglass insulation and outer fiberglass reinforced metalled vapour barrier jacket. Flexible duct rated for 12 m/s velocity and pressure rated for 500 Pascal positive and 500 Pascal negative.

Standard Acceptance: Thermaflex M-KE.

.6 Fiberglass ductwork to be used within the chlorine room.

.1 The ductwork is made of premium grade resins, filament wound over steel mandrels; the product meets the standards of UL 181, NFPA-90A and uniform Mechanical Code (UMC) 10-1 for non-metallic ducts.

.2 The product must be classified as a Class 1 Air Duct, meeting the 25/50 flame/smoke requirements of UL 181. Products to meet ASTM-E84 standard. Installation of all components and appurtenances to be completed in accordance with the manufacturers' instructions and must be resistant to high chlorine concentrations.

.3 Acceptable materials such as Perry 20S low-smoke ductwork products or approved equivalent.

Part 3 Execution

3.1 DUCT SEALING

.1 All supply, return and exhaust duct joints, longitudinal as well as transverse, should be sealed using:

.1 Low Pressure Ductwork:

- Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm use heavy mastic type sealant.
- Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.
- Other Joints: Heavy mastic type sealant.

.2 Duct tapes as sealing method are not permitted.

.3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.

.4 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application.

3.2 INSTALLATION

.1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.

.2 Coordinate the location of duct access doors. Refer to Section 23 33 00 – Air Duct Accessories.

.3 Fabricate ductwork from field measurements and not from plans and shop drawings exclusively. Failure to do so will not constitute an extra to the contract.

.4 Interrupt duct linings at fire, balancing backdraft and smoke dampers so as not to interfere with operation of devices. Provide sheet metal edge protection over linings on both sides of damper device.

.5 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty at no extra cost to the Contract.

.6 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters or bypass during cleaning.

.7 Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 450 mm, cross brace for rigidity. Open corners are not acceptable.

.8 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.9 Increase duct sizes gradually, not exceeding 15° divergence wherever possible. Maximum divergence upstream of equipment to be 30° and 45° convergence downstream.

.10 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled. Seal seams on fresh air and exhaust ducts watertight with mastic or low velocity duct sealant.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Access doors.

.2 Balancing dampers.

.3 Flexible connections.

1.2 REFERENCES

.1 National Fire Protection Association (NFPA)

.1 NFPA (Fire) 90A, Installation of Air-Conditioning and Ventilating Systems, 2015 Edition.

.2 NFPA (Fire) 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 2014 Edition.

.2 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).

.1 2011 ASHRAE HVAC Applications Handbook, SI Edition.

.3 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA 1966, HVAC Duct Construction Standards, Metal and Flexible- 3rd Edition 2005.

.2 SMACNA 016 -2012, HVAC Air Duct Leakage Test Manual, 2nd Edition.(replaced 1143).

.3 SMACNA, IAQ Guidelines for Occupied Buildings under Construction, 2007

1.3 QUALITY ASSURANCE

.1 Access doors shall be ULC labelled.

.2 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with ASHRAE Handbooks and SMACNA Duct Manuals.

1.4 SUBMITTALS

.1 Submit shop drawings of factory fabricated assemblies.

Part 2 Products

2.1 DUCT ACCESS DOORS

.1 Fabricate rigid and close-fitting doors of galvanised steel with sealing gaskets and suitable quick fastening locking devices. Duct access panels with screws are not acceptable. Install minimum 25 mm thick insulation with suitable sheet metal cover frame for insulated ductwork.

.2 Fabricated with two butt hinges and two sash locks for sizes up to 450 mm two hinges and two compression latches with outside and inside handles for sizes up to 600 mm x 1200 mm and an additional hinge for larger sizes.

2.2 BALANCING DAMPERS

.1 Fabricated of galvanised steel, minimum 1.6 mm. Full blade-length insulated shafts with blades rigidly fastened along entire blade length.

.2 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to 400 mm deep and on accessible round ducts.

.3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts 425 mm and over in depth and on all inaccessible rectangular and round ducts.

.4 On rectangular ducts up to 275 mm deep construct of single blade (butterfly) type.

.5 On rectangular ducts 300 mm to 400 mm deep construct of two opposed blades mechanically interlocked with pivots at quarter points.

.6 On rectangular ducts over 425 mm deep construct of multiple opposed blades mechanically interlocked with blades no greater than 200 mm deep and pivots equally spaced.

.7 On round ducts construct of single blade (butterfly) type. On 500 Pascal class and on all dampers over 300 mm diameter fabricate with full blade-length shaft.

.8 Provide over-ride limiting stops on all operating mechanisms.

.9 On round ductwork install operating mechanism on a steel mounted base firmly secured to the ductwork.

.10 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

.11 On fiberglass ductwork, the damper and adjustment lever must be made of the same material as ductwork; see products by MK Plastics or approved equivalent.

2.3 FLEXIBLE CONNECTIONS

.1 Fabricate of ULC approved neoprene coated flameproof glass fabric approximately 150 mm wide tightly crimped into metal edging strip and attached to ducting and equipment by screws or bolts at 150 mm intervals. Flexible connection airtight at 500 Pa. Do not use flexible connections to connect kitchen ductwork to kitchen fans where the fan is mounted inside the building enclosure. Fan connections in these cases shall be governed by NFPA 96 (flanged connections).

Part 3 Execution

3.1 APPLICATION

.1 Provide access door minimum 450 mm x 350 mm or 50 mm smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:

.1 At all locations of internally duct mounted devices including automatic dampers, damper motors and control sensors and devices.

.2 Provide balancing dampers at points on supply and exhaust systems where branches are taken from larger ducts as required for proper air balancing.

.3 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and/or where indicated on drawing.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Indicate the following:

.1 Performance data.

.2 Quality assurance submittals:

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

.1 Opposed blade type as indicated.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Performance:

.1 Leakage: in closed position less than 2% of rated air flow at 1000 Pa differential across damper.

.2 Pressure drop: at full open position less than 5.0 Pa differential across damper at 5 m/s.

.6 Insulated aluminum dampers:

.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.

.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

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 datasheet.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper.

.5 Ensure dampers are observable and accessible.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 01 - Common Work Results for Mechanical.

.2 Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCES

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

.1 ANSI/AMCA Standard 99-2016 Standards Handbook.

.2 ANSI/AMCA Standard 210-2016 /(ANSI/ASHRAE 51-16), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 ANSI/AMCA Standard 300-2014, Reverberant Room Method for Sound Testing of Fans.

.4 ANSI/AMCA Standard 301-2014, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

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 HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide:

.1 Fan performance curves showing point of operation, bhp and efficiency.

.2 Sound rating data at point of operation.

.2 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.2 Minimum performance achievable with variable speed controllers.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.1 Provide:

.1 Matched sets of belts.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.3 List of specialized tools necessary for adjusting, repairing or replacing.

1.5 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 off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect HVAC fans from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

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 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.

.3 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.

.4 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 FANS GENERAL

.1 Motors:

.1 In accordance with Section 21 05 01 - Common Work Results for Mechanical supplemented as specified herein.

.2 For use with variable speed controllers.

.2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.5 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.3 INLINE CENTRIFUGAL FANS

.1 Fan wheels:

.1 Welded aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.

.3 Air foil, forward curved blades, as indicated.

.2 Bearings: grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, aluminum, for smaller wheels, braced, and with welded supports.

.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide latched airtight access doors with handles.

.4 Variable volume control devices:

.1 Mounted by fan manufacturer.

2.4 CABINET FANS - GENERAL PURPOSE

.1 Fan characteristics and construction: as centrifugal fans.

.2 Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, variable speed drive.

.3 Fabricate casing of zinc coated or phosphate treated steel, reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to MPI #18. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 50 mm thick rigid acoustic insulation, pinned and cemented.

2.5 IN-LINE CENTRIFUGAL FANS

.1 Characteristics

.2 Air flow: 219 L/s (465cfm)

.3 Static Pressure: 75pa (0.3inches)

.4 Such as model SQ-85-VG by Greenheck or approved equivalent.

.5 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

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.

.1 Visually inspect.

.2 Inform Engineer of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 FAN INSTALLATION

.1 Provide sheaves and belts required for final air balance.

.2 Bearings and extension tubes to be easily accessible.

.3 Access doors and access panels to be easily accessible.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.2 Section 23 07 15 – Thermal Insulation for Piping.

1.2 REFERENCES

.1 American Conference of Governmental Industrial Hygienists (ACGIH)

.1 ACGIH Industrial Ventilation Manual of Recommended Practices, 25th Edition:

.1 Overhead: Print VS-907.

.2 Under Floor: Print VS-908.

.2 National Fire Protection Association (NFPA)

.1 NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 2015 Edition

.2 NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapours, Gases, Mists, and Non-combustible Particulate Solids. 2015 Edition.

.3 NFPA 211, Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances, 2016 Edition

.3 American Society for Testing and Materials International, (ASTM)

.1 ASTM C700-11, Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.

.4 National Building Code (2015)

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit detailed shop drawings and product data of chimney and all related accessories.

1.4 CERTIFICATIONS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by the manufacturer from independent testing agency signifying adherence to codes and standards.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Divert unused metal and wiring materials from landfill to metal recycling facility.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.6 EXTRA MATERIALS

.1 Furnish list of manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

Part 2 Products

2.1 COMBUSTION GASES EXHAUST CHIMNEY

.1 Black Steel:

.1 Black steel, schedule 40, entirely welded, flanged connection to flexible pipe.

.2 Connect to generator exhaust.

.3 Thermal insulation as specified in Section 23 07 15 – Thermal Insulation for Piping.

.4 Horizontal, mitered outdoor exhaust as indicated.

.2 Pre-fabricated stainless steel chimney

.1 General: Double-wall chimney with a 50 mm (2”) mineral fiber insulation.

.2 External wall made of 304 stainless steel, 24 gauge.

.3 Internal wall made of 304 stainless steel, 20 gauge.

.4 Characteristics:

.1 Diameter: inside diameter, ID (see drawing); outside diameter OD = ID + 100 mm (4”).

.2 Section lengths: 1219 mm (48”), 915 mm (36” and 300 mm (12”).

.3 Total length: see drawings

.4 Termination adaptors: rainshield adaptor, RSH.

.5 Elbow (45°) elbow: Model No.E-45.

.6 Lateral 45° elbow: Model No. T-45.

.7 Drainable cap: Model DC.

.8 Expansion joint: Model EJ.

.9 Safety valve: Model RV.

.10 Wall firestop spacer: Model WFS.

.11 Support rings: Models HB, WB and/or SB.

.12 Supply and install all other required accessories and adaptors to supply a complete installation.

.5 Present construction drawings and technical sheets for verification before the release for production.

.6 Such as Model IPL2 by Cheminée Lining or approved equivalent.

2.2 ACCESSORIES

.1 Total length: as indicated

.2 Expansion joint: Designed to compensate for linear expansion, c/w assembly band and finishing band, K factor same as pipe length.

.3 Drain-Tee cap: Install at the bottom of the vertical section, for collection of rainwater or condensation, for connection to 19mm drain.

.4 Relief valve: Shall be set to open at exhaust pressure exceeding 6.89 kPa. In accordance with NFPA 37.

.5 Supports: refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.6 Provide rain shield at extremity and drain-tee cap at the base.

.7 Install an anti-draft cap such as Vacu-Stack by Northline or approved equivalent.

Part 3 Execution

3.1 INSTALLATION

.1 The stack system shall be installed according to the manufacturer's installation instructions, NFPA 37, NFPA-211 and NBC.

.2 Portion of stack outside the building and above the roof shall be in conformity with local requirements, ULC standard an NFPA.

.3 Slope to low point for drainage

3.2 TESTS

.1 Leak tests as follows:

.1 3 hours continuous diesel engine operation.

.2 24 hours stopped.

.3 3 hours continuous diesel engine operation.

.4 24 hours stopped.

.5 Prove perfect leak proof with 2 hours at 10 kPa pressure. Use a detection fluid.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Boiler Manufacturers Association (ABMA)

.2 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2015.

.3 CSA Group

.1 CAN1-3.1-77(R2011), Industrial and Commercial Gas-Fired Package Boilers.

.2 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.

.3 CSA B139-15, Installation Code for Oil Burning Equipment.

.4 CSA B140.7-05(R2010), Oil Burning Equipment: Steam and Hot-Water Boilers.

.5 CSA B149.1-15, Natural Gas and Propane Installation Code.

.6 ANSI Z21.13-14/CSA 4.9-14, Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.4 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

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 heating boilers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nunavut, Canada.

.2 Indicate on drawings:

.1 General arrangement showing terminal points, instrumentation test connections.

.2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.3 Foundations with loadings, anchor bolt arrangements.

.4 Piping hook-ups.

.5 Equipment electrical drawings.

.6 Burners and controls.

.7 All miscellaneous equipment.

.8 Flame safety control system.

.9 Breeching and stack configuration.

.10 Stack emission continuous monitoring system to measure CO, O, NOx, SO, stack temperature and smoke density of flue gases.

.3 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75%, 100% of design capacity.

.2 Radiant heat loss at 100% design capacity.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for heating boilers for incorporation into manual.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance applicable Provincial /Territorial regulations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra materials:

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.1 Special tools for burners, access opening, handholes and Operation and Maintenance.

.2 Spare parts for 1 year of operation.

.3 Spare gaskets.

.4 Spare gauge glass inserts.

.5 Probes and sealants for electronic indication.

.6 Spare burner tips.

.7 Spare burner gun.

.8 Safety valve test gauge.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect boiler and equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CAST IRON BOILER

.1 Boiler construction

.1 Cast Iron sections

.2 Assembled with short, individual draw rods.

.3 Cast with sealing grooves for high temperature sealing rope to assure permanent gas-tight seal.

.4 Sealed watertight by elastomer sealing rings, not cast iron or steel nipples. Each port opening is machined to completely capture sealing ring between sections.

.5 Must be hydro-wall design to provide completely water-cooled combustion chamber.

.6 Provided with sufficient tappings to install required controls.

.7 Limited 10-year warranty against workmanship and defects to be in writing by manufacturer.

.2 Boilers

.1 Boiler to be designed with a top flue outlet.

.2 Provided with cast-in air elimination to separate air from circulating water.

.3 Provided with expansion tank tapping to divert separated air to expansion tank.

.4 Constructed to provide balanced water flow through entire section assembly using single supply and return connections for water. No external headers are necessary for water. Steam requires an external header 24” minimum from the waterline to the bottom of the header.

.5 Designed with a low silhouette to provide maximum headroom.

.6 Furnished with insulated burner mounting plate having necessary holes and tappings to mount burner. High temperature sealing rope is used to provide permanent gas-tight seal between front section and plate.

.7 Furnished with two observation ports (one in front and one in back) to allow visual inspection of the flame.

.8 Provided with steel flue damper assembly with a built-in adjustable damper capable of being locked into place after adjustment.

.9 Furnished with flanged aluminized steel flue collector hood bolted to top of section assembly.

.10 High temperature sealing rope used to provide permanent gas-tight seal between hood and section assembly.

.11 Furnished with heavy-duty ¼” steel cleanout plates to cover cleanout openings on the side of the boilers.

.12 Port openings must be of captured seal design – a machined groove assures uniform compression of the sealing ring and protects the seal from contaminants. Elastomer sealing rings are to be used to provide permanent watertight seal between sections. Unlike cast iron or steel push nipples, the elasticity of the seals fills any gaps caused by misalignment or expansion and contraction.

.13 Provided with flexible refractory blankets to be attached to back and floor of combustion chamber.

.14 Shipped with insulated heavy gauge steel jacket(s) with durable powdered paint enamel finish. Jacket designed to be installed after connecting supply and return piping.

.15 Jacket design will allow easy access to top and sides of boiler for maintenance and/or inspection without use of tools.

.3 Boiler trim:

.1 All electrical components to be of high quality and bear the U.L. label.

.2 Water boiler(s) standard controls furnished:

.1 Combination low temperature limit (operating) and high temperature limit control.

.2 Low temperature limit set according to system design. High temperature limit set at least 20°F higher than the low limit (240°F is the maximum allowable water temperature).

.3 Combination pressure-temperature gauge with dial clearly marked and easy to read.

.4 ASME certified pressure relief valve, set to relieve at 50 PSIG. Side outlet discharge type; contractor to pipe outlet to floor drain or near floor, avoiding any area where freezing could occur.

.3 Low water cut-off for boilers:

.1 Boilers to be furnished with U.L. labeled low water cut-off with ASME working pressure rating equal to or exceeding the maximum boiler working pressure as shown on the boiler's rating label. Install cut-off according to manufacturer's instructions.

.2 Do not use quick-connect fittings on boilers.

.3 Locate so burner shuts down if boiler water level falls below allowable safe waterline.

.4 Burner and Control Panels:

.1 Burner

.1 Burner fuel supply system and burner installation to conform to burner manufacturer's installation instructions and applicable codes.

.2 Burner motor characteristics: 120/60/1

.3 Control characteristics 120/60/1.

.4 Burner fuel – 2 fuel oil.

.5 Code - standard boiler

.6 Burners to have U.L. label(s) supplied by the burner manufacturer.

.7 Burners designed to ensure high efficiency and good performance under forced draft conditions with 0.1" W.C. positive pressure at the flue collar.

.8 Burners to be adjusted to provide 12% CO2 (± ¼%) with zero smoke for oil firing.

.9 Burners manufactured by: Power-Flame

.10 Burner operating mode: modulating

.2 Panel options – power on/fuel on light is standard on all burners with panels.

.1 Call For Heat

.2 Ignition On
.3 Pilot Failure
.4 Low Water
.5 Flame Failure
.6 Silencing Switch
.7 Control Fuse and Holder
.8 Post Purge Timer
.9 Alarm Bell

.5 Capacity:

.1 Oil input: 28.39L/min (7.5usgph)
.2 Gross output: 255kw (872MBH)
.3 Boiler HP: 26.
.4 Flue outlet dia.: 250mm.
.5 Such as Weil-Mcllain model 80-880 or approved equivalent.

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 datasheet.

3.2 INSTALLATION

.1 Install in accordance with ASME Boiler and Pressure Vessels Code, regulations of Territory having jurisdiction, except where specified otherwise, and manufacturers recommendations.

.2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.

.3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.

.4 Mount unit level

.5 Pipe hot water relief valves full size to nearest drain.

.6 Pipe blowdown/drain to blowdown tank/floor drain.

.7 Oil fired installations - in accordance with CSA B139.

3.3 MOUNTINGS AND ACCESSORIES

.1 Safety valves and relief valves:

.1 Run separate discharge from each valve.
.2 Terminate discharge pipe as indicated.
.3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

.2 Blowdown valves:

.1 Run discharge to terminate as indicated.

3.4 FIELD QUALITY CONTROL

.1 Commissioning:

.1 Manufacturer to:

.1 Certify installation.

.2 Start up and commission installation.

.3 Carry out on-site performance verification tests.

.4 Demonstrate operation and maintenance.

.2 Provide Engineer at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

3.5 Start-up and Service

.1 The contractor shall obtain the services of a factory-authorized agent to provide burner light off and adjustment. The start-up agent shall provide a burner light-off report as written proof that the burner was adjusted to optimum performance.

.2 The authorized agent shall provide a one-year service warranty after start-up.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code, 2015.

.2 CSA International

.1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Shop drawings to indicate project layout, including layout and dimensions of heat exchangers and system.

.1 Indicate manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.

.4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: submit manufacturer's installation instructions.

.7 Manufacturers Reports:

.1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance 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 off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect heat exchangers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PLATE AND FRAME HEAT ECHANGER

.1 Design:

.1 The unit shall be provided with an aluminum or stainless steel OSHA splash shield.

.2 The units shall be built in accordance with ASME code and when necessary be ASME Code stamped board registered.

.2 Frame:

.1 The frame plate and pressure plate shall be carbon steel SA 516 grade 70.

.2 The frame and pressure plate shall be of sufficient thickness to meet the ASME design pressure. Stiffeners or support brackets are not allowed.

.3 Carbon steel frame components shall be painted with epoxy paint.

.4 Units with four-inch or greater connections shall be unlined or alloy lined studded ports to mate with raised face or flat faced ANSI flanges. Rubber liners are not allowed.

.5 Units with two-inch or smaller connections shall have carbon steel female tapped NPT or male NPT connections if an alloy material is required.

.6 Units with two and half or three-inch connections shall be either studded ports or NPT as describe above.

.7 The frame design shall allow the thermal plates to be supported by the carry bar, top bar. The guide bar, bottom bar, shall only help properly align the plates.

.8 A roller assembly from the carry bar shall support the pressure plate for units taller than 60" and wider than 21”.

.9 Tightening bolts shall be zinc plated carbon steel SA193 B7.

.3 Plates

.1 Plates shall be constructed of 316 L Stainless Steel, DOUBLE WALL.

.2 Plates shall be pressed in a one-step stamping process.

.3 Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate and carry bar and guide bar. Welded on hanging brackets or stiffeners are not acceptable.

.4 Plates shall be permanently marked to indicate plate material and thickness.

.4 Gaskets

.1 The gaskets shall be a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination.

.2 Gaskets are to be “mechanically fixed”. Glued gaskets are not acceptable.

.3 The gaskets are to be made of NBR.

.5 Selection, Certification and Testing:

.1 The manufacturer shall hydro-test the unit to 1.3 times the design pressure as directed by ASME Code.

.6 Capacity: 404.1 kW (1,380,000 BTU/hr)

.1 Primary: Glycol (propylene): 9.7 L/s, 93.3 degrees C to 82.2 degrees C. Pressure drop: 31.92 kPa.

.2 Secondary: 12.6 L/s, 0.56 degrees C to 8.2 degrees C. Pressure drop: 55.2 kPa.

.3 Working pressure: primary 1034 kPa, secondary 1034 kPa.

.2 Dimensions: 355 mm wide, 787 mm high, 651 mm deep.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for heat exchanger installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of engineer.

.2 Inform Engineer 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 from Engineer.

3.2 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 General: install level and firmly anchored to supports as in accordance with manufacturer's recommendations.

.3 Plate exchangers: install in accordance with manufacturer's recommendations.

3.3 APPURTENANCES

.1 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

3.4 FIELD QUALITY CONTROL

.1 Site Tests and Inspections:

.1 Perform tests as directed by Engineer to ensure heat exchangers are functional.

.2 Obtain reports within 3 days of review and submit immediately to Engineer.

.2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

3.5 SYSTEM START-UP

.1 General: perform start-up operations in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.

.2 Check heater for cleanliness on primary and secondary sides.

.3 Check water treatment system is complete, operational and correct treatment is being applied.

.4 Check installation, settings, operation of relief valves and safety valves.

.5 Check installation, location, settings and operation of operating, limit and safety controls.

.6 Check supports, seismic restraint systems.

.7 General: perform performance verification in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.

.8 Timing: only after TAB of hydronic systems have been successfully completed.

.9 Primary side:

.1 Measure flow rate, pressure drop, and water temperature at heater inlet and outlet.

.2 Control valve: verify proper operation without binding, slack in components. Measure pressure and temperature at control valve inlet.

.3 Secondary side:

.1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.

.2 Verify installation and operation of air elimination devices.

.4 Calculate heat transfer from primary and secondary sides.

.5 Simulate heating water temperature schedule and repeat above procedures.

.6 Verify settings, operation, safe discharge from safety valves and relief valves.

.7 Verify settings, operation of operating, limit and safety controls and alarms.

.8 Reports:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

3.6 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.2 Waste Management: separate waste materials for reuse/recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 DEMONSTRATION

.1 Training: provide training in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as follows:

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by heat exchanger installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.2 PRODUCT DATA

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

.2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS acceptable to Labour Canada, and Health Canada.

.3 Submit product data sheets for unit heaters. Include:

.1 Product characteristics.

.2 Performance criteria.

.3 Mounting methods.

.4 Physical size.

.5 kW rating, voltage, phase.

.6 Cabinet material thicknesses.

.7 Limitations.

.8 Colour and finish.

.4 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.3 SHOP DRAWINGS

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

.2 Indicate:

.1 Equipment, capacity and piping connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials and with Waste Reduction Workplan.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Engineer.

.5 Fold up metal banding, flatten and place in designated area for recycling.

.6 Collect, package and store existing unit heaters for either reuse, recycling or rebuilding and return to recycler in accordance with Waste Management Plan.

Part 2 Products

2.1 UNIT HEATERS: (UH-01, UH-02, UH-03, UH-04, UH-05, UH-06)

.1 Heating Source: Glycol Heating Water

.2 Casing: 18 gauge steel with threaded connections for hanger rods.

.3 Coils: 16 gauge aluminized steel heat exchanger.

.4 Fan: Direct drive propeller type, statically and dynamically balanced. Horizontal models complete with sleeve bearings and fan guard.

.5 Air Outlet: Adjustable pattern diffuser on projection models and four-way louvers on horizontal throw models.

.1 Control:

.1 2 speed on-off switch key operated with integral overloads in cabinet.

.2 Control thermostat: room electric, rating to suit cabinet unit heater, locking cover, set point locking device, concealed adjustment, plastic cover and guard, thermometer in cover.

.6 Performance characteristics:

.1 EWT: 93.3 Deg.C

.2 LWT: 76.6 Deg.C

.3 Capacity: 7.3 kW

.4 Fan Motor:

.1 Rpm: 1140

.2 HP: 1/20

.3 115/ 1 phase/ 60 Hz.

.5 Fan flow rate: 280 L/s

.6 Such as Rosemex H-26-1R

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Provide double swing pipe joints as indicated.

.3 Check final location with Engineer if different from that indicated prior to installation.

.1 Should deviations beyond allowable clearances arise, request and follow Engineer's directive.

.4 Clean finned tubes and comb straight.

.5 Provide supplementary suspension steel as required.

.6 Install thermostats in locations as indicated.

.7 Before acceptance, set discharge patterns and fan speeds to suit requirements.

.8 Engineered chimney system:

.1 Install in accordance with manufacturer's recommendations.

.2 Ensure that chimney is adequately supported against local wind conditions.

.3 Provide hose connection to chimney drain.

.4 Maintain 2% slope toward unit heater.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 The specifications of Division 01 apply to Division 25.

.2 All sections of Division 25 are interrelated and complete one another as a whole.

.3 All mechanical and electrical drawings apply to Division 25.

1.2 RELATED SECTIONS

.1 All sections of Division 23.

.2 All sections of Division 26.

1.3 SUMMARY

.1 The scope of Division 25 consists of installing the new Control system with SCADA for the new pumping station.

.2 In general terms, the scope of Division 25 includes:

.1 The supply and installation of a new, complete and fully operational SCADA system utilizing Programmable Logic Controllers (PLC) technology as shown on drawings and described in these specifications.

.2 Programming of sequences of operation and graphical user interface (HMI).

.3 Start-up, verification and commissioning of the entire SCADA system.

1.4 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14 13, Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1 2000 (R2015), Industrial Control and Systems: General Requirements.

.3 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.

.1 IEEE 802.3, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

1.5 DRAWINGS AND SPECIFICATIONS

.1 The General Conditions, Supplementary Conditions and Division 01 are a part of this specification and shall apply to this Division.

.2 The intent of the drawings and specifications is to include all labour, products and services necessary for complete work, tested and ready for operation.

.3 Symbols used to represent various control devices often occupy more space on the drawing than the actual device does when installed. In such instances, do not scale locations of devices from control symbols. Install these devices with primary regard for usage of wall space, convenience of operation and grouping of devices.

.4 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.5 If discrepancies or omissions in the drawings or specifications are found, or if the intent or meaning is not clear, advise the Engineer for clarification before submitting tender.

.6 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.6 **ACRONYMS AND ABBREVIATIONS**

.1 Acronyms used in Division 25:

.1 AEL - Average Effectiveness Level.
.2 BC(s) - Building Controller(s).
.3 CDL - Control Description Logic.
.4 COSV - Change of State or Value.
.5 CPU - Central Processing Unit.
.6 DDC - Direct Digital Control.
.7 DP - Differential Pressure.
.8 HMI - Human Machine Interface.
.9 I/O - Input/Output.
.10 LAN - Local Area Network.
.11 PLC(s) – Programmable Logic Controller
.12 NC - Normally Closed.
.13 NO - Normally Open.
.14 OS - Operating System.
.15 O&M - Operation and Maintenance.
.16 OWS - Operator Work Station.
.17 PC - Personal Computer.
.18 PDA – Personal Digital Assistant.
.19 PI – Proportional and Integral.
.20 PID - Proportional, Integral and Derivative.
.21 RAM - Random Access Memory.
.22 SP - Static Pressure.
.23 SCADA – Supervisory Control and Data Acquisition system
.24 ROM - Read Only Memory.
.25 USB - Universal Serial Bus.
.26 UPS - Uninterruptible Power Supply.
.27 VFD - Variable Frequency Drive.
.28 WAN - Wide Area Network.

1.7 DEFINITIONS

.1 Point: may be logical or physical.

.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

.2 Physical points: inputs or outputs which have hardware wired to controllers to measure physical properties, to provide status conditions of contacts or relays or to provide interaction with related equipment (system start/stop, modulation control, etc.)

.2 Point Object Type: points fall into following object types:

.1 AI (analog input).

.2 AO (analog output).

.3 DI (digital input).

.4 DO (digital output).

.5 Pulse inputs.

1.8 SCOPE OF WORK

.1 Supply and install a complete and fully operational (SCADA) utilizing Programmable Logic Controllers (PLC) technology as shown on drawings and described in these specifications. All materials must be new.

.2 Provide all labour, material, equipment, system connections and software that may or may not be specifically referred to herein or on the drawings, that are required to meet the functional intent of these specifications.

.3 In general, the work covered by the sections of Division 25 includes, but is not limited to, the following:

.1 All electrical, electronic and PLC type controls required for the electro-mechanical equipment, unless specified as part of another section.

.2 Programmable Logic Controllers:

.1 Installation of new Programmable Logic Controllers, as required to comply with these specifications and Network Architecture.

.3 Field Control Devices:

.1 Supply and installation of new field control devices, as shown on drawings.

.4 Monitoring panels and local cabinets.

.5 Supply and installation of new local cabinets, as required.

.6 New Supervisory Control and Data Acquisition system including databases and operation software.

.7 Installation of software, applications, databases, etc. to support the Supervisory Control and Data Acquisition system (SCADA).

.8 Supply and installation of an Ethernet TCP/IP primary communication network, including active components, copper cables and conduit. The installation must be certified by a **Telecommunications specialist**.

.9 Supply and installation of new secondary communication networks (other than Ethernet TCP/IP) required for the SCADA.

.10 Complete electrical installation including conduits, cables, junction boxes, etc. required for control systems, automation and the SCADA, as shown on drawings and described in these specifications, as well as all electrical connections required to motor control centers and starters, interlocks for fans, pumps or other controls (e.g. device, panels).

.11 Supply and installation of all low voltage transformers required for controls and automation systems.

.12 All controls required for local controls: PLC or standalone digital controller, electric damper actuator (ME), motorized valve(s) and space sensor(s), etc. Refer to drawings.

.13 Heating system:

.1 Provide and install a TEKMAR 265 boiler standalone controller.

.14 Complete database required for PLC controls, the Supervisory Control and Data Acquisition system and all integrated systems part of the Supervisory Control and Data Acquisition system (SCADA).

.15 Update graphics at the facility operator working stations located at the waste water treatment plant.

.16 All programming is to be completed by the Owner.

.17 Start-up, testing, calibration and technical support during commissioning, full documentation.

.18 Assistance during the calibration and commissioning of electro-mechanical equipment.

.19 Complete operating and maintenance manuals.

.20 Training of personnel.

.21 Wiring interface co-ordination of equipment supplied by others.

.22 Miscellaneous work as specified in these sections and as indicated.

.4 Design Requirements:

.1 Provide emergency or normal power (120/1/60) to SCADA components, local monitoring panels and control cabinets from local 120/208V distribution panels. Dedicated circuits for use by Division 25 will be reserved in local distribution panels.

.2 Provide power (120V/1/60) from local Uninterrupted Power Supply (UPS) units to all PLC controllers, Supervisory Control and Data Acquisition system components, primary network (Ethernet TCP/IP) infrastructure and other control components considered as life safety or required to operate without interruption in case of a power failure.

.3 Provide low voltage power (24V) from local panels and transformers installed by this Division.

.4 Low voltage transformers: the use of a single transformer to supply multiple local controllers will be permitted provided the theoretical VA load connected is under 75% of the transformer's VA capacity.

.5 Location of controllers as reviewed by Project Manager prior to installation.

.5 The following work does not form part of Division 25:

.1 Access doors for controls equipment and instrumentation.

.2 Supply and installation of balancing valves.

.3 Installation of field devices provided by Division 25 but required to be installed by others. Refer to the item "EQUIPMENT TO PROVIDE TO OTHERS" in this section.

1.9 SUBMITTALS

.1 Make submittals in accordance with Section 25 05 02 – Controls: Submittals and Review Process.

.2 Quality Control:

.1 Unless otherwise noted, provide equipment and material from manufacturer's regular production, CSA and ULC certified, manufactured to standard quoted plus additional specified requirements.

.2 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 – Controls: Submittals and Review Process. Label or listing of specified organization is acceptable evidence.

1.10 QUALITY ASSURANCE

.1 Codes, Rules, Permits & Fees

.1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this work.

.2 Comply with all rules of the following standards:

.1 Canadian Electrical Code, CSA Standard C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations and the applicable building codes.

.2 Government of Nunavut's Good Building Practices Guideline – SEC. Ed. Dec., 2005.

.3 Electrical and Electronic Manufacturer's Association of Canada (EEMAC).

.4 National Electrical Manufacturer's Association (NEMA).

.5 Underwriter's Laboratories Incorporated (ULI).

.6 Underwriters Laboratories of Canada (ULC).

.7 Institute of Electrical & Electronic Engineers (IEEE).

.8 Illuminating Engineering Society (IES).

.9 InterNational Electrical Testing Association Standard for Acceptance Testing Specifications for Electrical Power, Equipment & System ANSI/NETA/ATS-2013.

.2 The SCADA/PLC Provider to comply with the following criteria:

.1 SCADA/PLC Contractor to be regularly engaged in the business of manufacturing and installing PLC-type Industrial controls for over twenty (20) years. Companies with less than 20 years of experience shall submit qualifications to Engineers.

.2 Employ a competent supervisor and a sufficient number of licensed tradesmen to complete the Work in the required time.

.3 Maintain a local staff of at least four technicians who factory-trained on the specific products to be used. These personnel are required to provide installation, instruction, routine and emergency service. Contractors shall provide names of qualified individuals and their certifications to be part of submission.

.4 Maintain or have direct access to a local supply of essential replacement parts for SCADA and PLC components.

.5 Arrange and install products to fit properly into designated building spaces.

.3 Installation:

.1 Have factory-trained and experienced personnel to perform the work described in all sections of Division 25.

.2 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

.4 All wiring for electrical work must be completed in accordance with Section 26 05 00 - Common Work Results for Electrical, manufacturer's recommendations.

1.11 MISCELLANEOUS WORK

.1 Provide instructions, monitor work and retain complete responsibility for all field control devices and equipment provided by Division 25, but installed by others (e.g. control valves, thermowells, VFDs, etc.)

.2 Coordinate wiring requirements of systems or equipment provided by others but required to be wired by Division 25. Obtain manufacturer's recommendations from the system provider.

.3 Coordinate wiring interface of equipment supplied by others.

1.12 EQUIPMENT TO PROVIDE TO OTHERS

.1 Provide to Division 23:

.1 Control valves for heating water network.

.2 Thermowells for temperature sensors installed on heating water network.

1.13 ELECTRICAL INSTALLATION

.1 Division 25 is responsible for the hiring of a qualified and licensed Electrical contractor for the following work:

.1 Complete electrical installation including all conduits, cables, junction box, etc. required for control and automation systems.

.2 120V single phase power source for PLC controls, local monitoring panels, cabinets and transformers provided by this Division.

.3 All connections to motor control centers or starters, interlocks for fans, pumps and other control components.

.4 Grounding systems required for all systems and devices provided under Division 25, in accordance with manufacturer's instructions and requirements of Division 26.

.2 Quality Assurance:

.1 The electrical contractor providing the electrical installation for Division 25 to be fully competent in the type of work described in these specifications and to be familiar with the electrical and grounding requirements of this type of installation.

.2 Provide qualified personnel that have been trained for the installation of electrical systems specific to DDC controls, instrumentation and networking infrastructure.

.3 Electrical contractor to hold a valid Master Electrical contractor license as issued by the Province that the work is being constructed.

Part 2 Products

2.1 SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM AND CONTROL SYSTEM (SCADA)

.1 There is an existing Allen-Bradley system presently installed in adjoining buildings. The new components must be entirely Allen-Bradley components that will match the existing.

.2 The new PLC Controllers and Supervisory Control and Data Acquisition system shall be from the same manufacturer and product line.

.3 The SCADA shall have the capability of interfacing with third party control systems including pump packages and other control systems provided they comply with the communication protocol used on the existing site.

.4 The graphics package of the HMI must ensure continuation of the existing HMI system.

2.2 SCADA - PRIMARY NETWORK

.1 SCADA communication at the primary level will be provided in conformance with:

.1 Ethernet standard.

.2 TCP/IP protocol suite.

2.3 QUALITY OF PRODUCTS

.1 All products provided shall be CSA Approved, Canadian Underwriters' Laboratory approved where applicable, and new, unless otherwise specified.

.2 If products specified are not CSA approved, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval

.3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Engineer.

.4 Verify with the Electrical Inspection Department the acceptability of any pre-wiring done outside the territory of Nunavut and ensure that a permit is acquired.

2.4 PRODUCT FINISHES

.1 Finish all cabinets, panelboards, switchboards, equipment cabinets, cable trays, etc. in ANSI 61 grey enamel unless otherwise specified.

.2 Apply primer on all items, which are to be finished on the job.

.3 Touch up all damaged painted finishes with matching lacquer, or, if required by the Engineer, completely repaint damaged surface.

2.5 ALTERNATIVE PRODUCTS

.1 Suppliers to submit all requests for alternative product approval to the Engineer. Submissions must be received by the Engineer not less than seven (7) working days prior to the close of tenders. Submissions received after the "Cut-Off' date will not be reviewed.

All submissions which are approved by the Engineer shall be identified as "Approved Alternatives" in an Addendum. Alternative products not listed in the Addendum will be rejected.

.2 The Contractor shall assume full responsibility for ensuring that when providing alternative products or materials, all space, weight, connections, power and wiring requirements etc. are considered. Any costs incurred for additional components, changes to services, structural or space requirements, layouts and plans, etc. that may be necessary will be borne by the Contractor.

.3 All submissions to be provided with technical data and whatever pertinent information that may be required by the Engineer to evaluate equivalency to the specified product. The responsibility to provide sufficient technical data with respect to submissions will remain solely with those making the submission.

Part 3 Execution

3.1 GENERAL

.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.

.2 All controls components must be easily accessible for maintenance.

.3 Install all field devices in control cabinets.

3.2 SITE EXAMINATION

.1 All controls shall be installed and adjusted by specialized technicians, regularly employed by the SCADA and PLC manufacturer. All costs related to adjustments form part of this contract.

.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.

.3 Report to the Engineer any unsatisfactory conditions which may adversely affect the proper completion of this work.

3.3 COORDINATION WITH OTHER DIVISIONS

.1 Examine the drawings and specifications of all divisions and become fully familiar with their work. Before commencing work, obtain a ruling from the Engineer if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.

.2 Coordinate with all Division installing equipment and services, and ensure that there are no conflicts.

3.4 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.5 ELECTRICAL INSTALLATION

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Modify starters to provide for PLC as indicated on drawings. Refer to electrical control schematics included as part of control design schematics on drawings. Provide wiring schematics including additions, deletions to control circuits.

.3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.4 Provide grounding for controls systems and the PLC installation in accordance with Division 26.

.5 Variable Frequency Drives (VFDs): mounting and 600VAC connections of all VFDs are to be done by Division 26.

.6 Wiring:

- .1 Wiring must be continuous without joints.
- .2 All wiring shall be run in EMT conduit unless specified otherwise.
- .3 Maximum conduit fill not to exceed 50%.
- .4 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Engineer to review before starting Work.
- .5 Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .6 Wiring sizes:
  - .1 120 V: #12AWG minimum.
  - .2 24 V: #18AWG minimum.
  - .3 Power loss through conductor shall not exceed 5%.

.7 Ethernet Network:

- .1 All Ethernet cables, for connection of IP-enabled devices to the Controls, shall be supplied by Division 25 and certified by a Telecommunications Specialist.
- .2 Division 25 is responsible for providing the EMT conduit infrastructure that will be used to run Ethernet cables to SCADA/PLC and integrated devices.
- .3 In all cases, coordinate with the Telecommunications Specialist to ensure the conduit infrastructure deployed complies with EIA/TIA standards.

3.6 PAINTING

.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.

.3 Clean and prime exposed hangers, racks, fastenings, and other support components.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 01 – Controls: General Requirements.

1.2 SUBMITTALS

.1 In addition to submittals required in Division 01, provide all shop drawings and closeout documentation in accordance with the requirements of this section

.2 Shop Drawings: provide an electronic copy of shop drawings in PDF format.

.3 Closeout Documents: submit preliminary copy for Engineer's review. Following the review, make corrections as requested and provide (5) hard copies and (5) "back-up" copy (PDF – multipage format) on DVD of the closeout documents. Closeout documents must also be entered on the facility OWS.

1.3 SHOP DRAWING REVIEW

.1 Submit detailed shop drawings before start of installation and include following:

- .1 Equipment List Summary indicating manufacturer and model number of equipment to be used and the associated equipment Id.
- .2 For each system under control of the SCADA, provide control and wiring schematics showing: all controllers involved in the regulation of local control loops, all field devices, control elements schematic diagrams of system controlled, sequences of operation, etc. Label all control points, control elements, terminals, etc.
- .3 List and description of software programs and applications provided.
- .4 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
- .5 Detailed network architecture showing PLC control units, components of the SCADA, communication interfaces, control networks, communication protocols used and cable types.
- .6 Single line diagrams showing cable routings, conduit sizes and cable lengths for Ethernet TCP/IP networks.
- .7 Detailed system architecture showing all points associated with each controller.
- .8 Complete Points List for each controller with indication of spare points capacity by number and type.
- .9 Floor plans showing location of main controllers (SCADA/PLCs), monitoring panels and auxiliary control cabinets.
- .10 Detailed layouts of each control panel including a bill of materials and system schematics.
- .11 Wiring schematics for low voltage power supply network showing local distribution panels, transformers and other equipment. Provide load calculations for control transformers and power supplies.

.12 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, normal position, required torque, actual torque and close off pressure (required and actual).

.13 Damper actuators: complete schedule listing including following information: designation, system, point ID, manufacturer, model, damper dimension and type, normal position, spring details, required torque, actual torque.

1.4 CLOSEOUT DOCUMENTATION

.1 Submit closeout documentation once system start-up, verification and commissioning has been completed, in accordance with Section 25 05 11 - Controls: Start-up, verification and commissioning and Section 23 08 00 – Mechanical Systems Commissioning.

.2 Closeout documents to include final “Operations and Maintenance” manual and all as-built data related to the completed Controls installation, including:

.1 Corrected and updated version of all information requested in the shop drawings reviews, in accordance with the as-built system

.2 All testing and commissioning reports, in accordance with Section 25 05 11 – Controls: Start-up, verification and commissioning.

.3 Copy of all system programs and documentation for their use.

.4 Copy of all software programmed including database, graphics, parameters, etc.

.5 List of alarm limits programed (high and low for each type).

.6 List of points assigned to schedule and event programs.

.7 Updated floor plans showing location of all main controllers (PLCs), SCADA workstations and/or servers, monitoring panels, auxiliary control cabinets and local controllers.

.8 Training documentation.

.9 Certification and warranty of primary network (Ethernet TCP/IP).

1.5 QUALITY ASSURANCE

.1 Preliminary Design Review Meeting: Convene meeting to:

.1 Undertake functional review of preliminary design documents, resolve inconsistencies.

.2 Resolve conflicts between contract document requirements and actual items.

.3 Review "Sequence of Operations".

.2 System programmers (SCADA/PLCs) to attend meeting.

.3 Engineer retains right to revise sequence or subsequent CDL prior to software finalization without cost to Owner.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 01 – Controls: General Requirements.

.2 Section 25 05 02 – Controls: Submittals and Review Process.

.3 Section 25 30 02 – Controls: Field Control Devices.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14 13, Industrial Control Equipment.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 25 05 02 – Controls: Submittals and Review Process, supplemented and modified by requirements of this Section.

.2 Submit to Engineer for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

.1 Panels include: control panels, controller enclosures, monitoring panel and auxiliary control cabinets.

.2 Identify by Plastic laminate, 3 mm thick black core, square corners, lettering accurately aligned and engraved into core.

.3 Sizes: 25 x 67 mm minimum.

.4 Lettering: minimum 7 mm high, black.

.5 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by plastic tie.

.2 Sizes: 25 x 50 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include: point name and point address.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

.1 Identify each device with pre-printed electronically generated self-adhesive vinyl labels, black lettering on clear backing.

.2 Data to include: name and point address.

.3 Labels to be cut and apposed neatly on room sensor.

.4 Location: as directed by Engineer.

.5 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of SCADA/PLC.

.2 Sign to read: "Caution: This equipment is under automatic remote control of SCADA/PLC" as reviewed by Engineer**.**

2.5 FIELD DEVICES INSIDE PANELS

.1 Identify each device installed within a control cabinet or monitoring panel using pre-printed electronically generated self-adhesive vinyl labels.

2.6 WIRING

.1 Power wiring.

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1.

.3 Power wiring: identify circuit breaker number and panel ID inside each control panel.

.2 SCADA and PLCs wiring.

.1 Identify field device and network wiring end-to-end with plastic rings printed with indelible number markings. Alternatively, use pre-printed labels specifically designed for wiring identification.

.2 Inside control panels, label terminals of terminal blocks with the same identification used on wiring schematics.

.3 Use distinctive colour coded wiring for the following applications:

.1 Communications cables: Orange, matched throughout system.

.2 I/O cables: White.

.3 Low voltage power: Black/White.

2.7 CONDUIT

.1 Colour code SCADA/PLCs conduits.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint and confirm colour with Engineer during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 NAMEPLATES AND LABEL ELECTRICAL PANELS

.1 Correct panel schedules to reflect changes made during Work.

.2 Naming conventions: confirm naming conventions for circuit description with Engineer before proceeding.

3.3 CONTROL PANELS

.1 Provide Points List and Controller Layout (showing each control point) for each controller located inside a control panel. Install Points List and Controller Layout on the door inside the panel enclosure.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 01 – Controls: General Requirements.

1.2 DEFINITIONS

.1 For additional acronyms and definitions refer to Section 25 05 01 – Controls: General Requirements.

1.3 SUBMITTALS

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

.2 Submit maintenance documentation in accordance with Section 01 33 00– Submittal Procedures supplemented by requirements of this section.

.3 Submit detailed preventative maintenance schedule for system components.

.4 Revise and submit to Owner "As-built drawings" documentation, technical documentation and commissioning reports to reflect changes, adjustments and modifications to the Controls made during warranty period.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.

.2 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This section covers networks at the Automation Level, the level at which the Controls and automation systems perform communication.

1.2 RELATED SECTIONS

.1 Section 25 05 01 – Controls: General Requirements.

.2 Section 25 30 01 – Controls: Building Controllers.

1.3 REFERENCES

.1 Electronic Industries Alliance (EIA)/Telecommunications Industries Association (TIA) :

.1 EIA/TIA-568- Commercial Building Telecommunications Cabling Standards Set, Part 1 - General Requirements, Part 2 - Balanced Twisted-Pair Cabling Components, Part 3 - Optical Fiber Cabling Components Standard.

.2 EIA/TIA-569- Commercial Building Standard for Telecommunications Pathways and Spaces.

1.4 SYSTEM DESCRIPTION

.1 Data communication Local Network:

.1 A primary Ethernet TCP/IP network allows high-speed communication between PLCs and OWS's (hereby identified as nodes) and ensures reliable data transfer between all system components.

.2 Communication with other buildings:

.1 A fibre optic link to communication with the site other existing buildings.

.2 An Ethernet Modem to be used as a backup communication device with the other building in case of failure of the fibre optic system.

.3 Connection Points:

.1 Within the facility, a connection point must be provided to each IP-based components part of the Controls including: control units (PLCs), Human Machine Interface (HMIs), integrated third-party panels (lighting, meters, etc.), for connection to the primary Ethernet TCP/IP network.

.2 In addition a service connection point must be provided at each main panel (PLCs) to connect a laptop. In locations where several panels are grouped in proximity, a single service connection can be provided.

1.5 DESIGN REQUIREMENTS

.1 Local Network.

.1 High speed, high performance, local area network over which computers communicate with each other directly on peer to peer basis in accordance with the Ethernet standard and TCP/IP.

.2 High speed data transfer rate for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices.

.3 Complete access to system data is possible from any location on the primary network (Ethernet TCP/IP).

.4 Every building controller is accessible from any location on the primary network with the full capability to read/write properties in controller's operating software and programming.

.5 Transparent "peer to peer" network operation: detection and accommodation of single or multiple node failures. Defective nodes are automatically off-loaded the network without causing any network interruption. New nodes are automatically detected and integrated to the network.

.6 In the event a network segment fails, the two resulting networks are reconfigured into two separate networks, both ensuring transparent "peer to peer" communication between their associated nodes.

.7 Operational equipment to continue to perform designated functions effectively in event of single or multiple failures of nodes and/or network.

.8 Devices on the primary network to support operation rate of 100 Megabits per second.

.9 Dynamic Data Access:

.1 Network to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices residing on network.

1.6 PRIMARY NETWORK – AUTHORIZED INSTALLER

.1 The installation of the primary network (Ethernet TCP/IP) shall be done by a specialized telecommunication installer.

.2 The installer shall be certified by the manufacturer for the supply and installation of the complete structured cabling system (copper cables, fibre optic, connectors, interface, etc.) to ensure the final system is certified and done in compliance with the manufacturer's requirements and guarantees.

.3 Provide documentation certifying the installer as a "manufacturer authorized installer".

1.7 REMOTE BUILDINGS

.1 Remote Buildings will be connected to the new Char Lake Pumping Station using a new fibre optic link. Use fibre the optic link to connect the new building the existing Controls architecture.

.2 Provide fibre optic interfaces (Edge switches) to connect existing fibre optic cables to new Controls segment (copper CAT-5E).

.3 Provide and configure a new Ethernet Modem to be used as a backup communication links with the other buildings in case of failure of the fibre optic communication.

Part 2 Products

2.1 SWITCHES

.1 All Ethernet switches shall ensure a network operation at 100 Mbps. Provide 25% free space at each switch.

.2 Depending on the types of cable used, switch connection points will be fibre optic or copper.

.3 For mounting inside control panel, industrial grade Ethernet switch, complete with DIN-rail mounting, as per EDS series from Moxa or approved equivalent from Hirschmann or Cisco.

2.2 NETWORK WIRING

.1 Local network:

.1 Depending on distances, noise and interference requirements, cables shall be copper Category 5E or fibre optic. Refer to drawings.

2.3 ACCEPTABLE MANUFACTURERS

.1 Structured cabling system (primary network):

.1 Belden.
.2 Panduit.
.3 Siemon.
.4 Anixter.

.2 Ethernet switch – Industrial grade:

.1 Moxa.
.2 Hirschmann.
.3 Cisco.

Part 3 Execution

3.1 LOCAL NETWORK

.1 Network installation shall be by a specialized telecommunication installer. Refer to article “LOCAL NETWORK – AUTHORIZED INSTALLER”.

.2 Except for connection points to switches (maximum 3 m) or inside panel, network wiring shall be run in conduits. Installation must comply with the manufacturer’s standards and installation recommendations.

.3 Installation must comply with all applicable EIA/TIA standards.

.4 After completion of the installation, telecommunication installer to provide a verification report in accordance with applicable EIA/TIA standards and the system certification.

.5 Prior to the installation, submit the following for review: floor plans indicating cable runs, datasheets of proposed network cables and active components to be used, installation procedures, etc.

.6 Connection Points:

.1 Inside the control panel enclosure, provide space for the installation of a small patch box with RJ45 module(s). Patch box to be provided and installed by the telecommunications installer.

.2 Cables and terminations to be tested and certified end-to-end by the telecommunications installer.

.3 Provide, CAT-5E pre-certified patch cables (1-3 feet), for connection of controllers (PLCs) or other IP-based components to the RJ45 patch box inside the panel enclosure.

3.2 IDENTIFICATION

.1 Identification of network cabling, equipment and enclosures in accordance with Section 25 05 54 – Controls: Identification.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 01 – Controls: General Requirements.

.2 Section 25 10 01 – Controls: Automation Networks.

.3 Section 25 30 02 – Controls: Field Control Devices.

.4 Section 25 90 01 – Controls: Site Requirements, Applications and Systems, Sequences of Operation.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14 13, Industrial Control Equipment.

.2 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE C37.90.1 2012, IEEE Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 – Controls: General Requirements.

1.4 GENERAL

.1 Provide and install a distributed type Supervisory Control and Data Acquisition system (SCADA), utilizing Programmable Logic Control (PLC) technology to perform the control and supervision of equipment related to pumping stations, etc., as specified in the current section.

.2 Provide and install a complete and fully operational system including all equipment required for data processing, operator devices, sensors, field devices, software, wiring, conduits, electrical connections, communication cables and interfaces, and all auxiliary equipment required for the proper operation of the system. The current section is responsible for the system's verification, calibration and fine-tuning.

.3 The SCADA must be provided and installed by the manufacturer. Provide staff under employment of the SCADA Contractor, which are trained and qualified for this type of installation. Ensure qualified supervisory personnel continuously direct and monitor work.

.4 Programming, configuration and commissioning of Programmable Logic Controllers and the associated Supervisory Control and Data Acquisition system will be performed by the owner.

.5 The Centralized Management System and Building Controllers must be from the same manufacturer and product line.

.6 All equipment must be standard and regularly manufactured for this type of installation. Provide materials and equipment, which have been carefully tested and approved for this type of installation.

1.5 SYSTEM DESCRITION

.1 Provide and install a distributed type Supervisory Control and Data Acquisition system (SCADA), utilizing Programmable Logic Control (PLC) technology to perform the control and supervision of equipment related to the pumping stations, etc.,

.2 The SCADA must be Allen Bradley Compact Logix PLC, as per plant standards.

.3 The communication network between the PLCs must be in accordance with Ethernet and TCP/IP, including all structured cabling and communication devices (interfaces, switches, etc.).

.4 The communication network between the sites is 12-strand optical fiber cables.

.5 Human-Machine-Interfaces (HMIs) allow the display of system graphics and the modification of points/objects and their associated parameters. The Panel Mounted Display (HMI) shall be programmed with screens to graphically display the operation of a process . As a minimum, it will be programmed to display the processes with statuses and command values. The final screens will be developped with the owner.

.6 The SCADA must be provided and installed by the SCADA contractor. Provide staff under employment of the SCADA Contractor, which are trained and qualified for this type of installation. Ensure qualified supervisory personnel continuously direct and monitor work.

.7 Programming, configuration and commissioning of Programmable Logic Controllers and the associated Supervisory Control and Data Acquisition system will be performed by the owner.

.8 The operation of Char Lake will depend on receiving signals from Signal Hill. As such, data will be exchanged between the two sites on the SCADA network. Backup dial-up Ethernet modems will be used at these two sites so that communication can still be maintained between them in the event of failure of the main SCADA optical fiber.

.9 All equipment must be standard and regularly manufactured for this type of installation. Provide materials and equipment, which have been carefully tested and approved for this type of installation.

Part 2 Products

2.1 SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM

.1 General: Control System which includes the main controller, power supply, and I/O module. The SCADA system is to be from Allen Bradley CompactLogix 5370 L3 family.

.2 The SCADA system is to include:

.1 Allen Bradley CompactLogix 1769-L33ER 5370 L3 processor with 2MB of memory.

.2 Allen Bradley CompactLogix 1769-PA4 Power supply.

.3 Allen Bradley CompactLogix 1769-IQ16 16 point 24VDC Input Module.

.4 Allen Bradley CompactLogix 1769-OB16 16 point 24VDC Output Module.

.5 Allen Bradley CompactLogix 1769-OF8C 8 Channel 4-20 ma Analog Output current Module.

.6 Allen Bradley CompactLogix 1769-IF8 8 Channel 4-20 ma Analog Input Module.

.7 Allen Bradley CompactLogix 1769-IA16 16 point 120 VAC Input Module.
.8 Allen Bradley CompactLogix 1769-ECR Right End Cap.

Must also utilize wiring system 1492:
.9 Allen Bradley 1492-IMF20F-F24A-2 Interface module for IQ16 Module.
.10 Allen Bradley 1492-IMF20F-F120A-2 Interface module for IA16 Module.
.11 Allen Bradley 1492-XIM2024-16RF Relay module for OB16 Module.
.12 Allen Bradley 1492-AIFM8-F-5 Interface module for IF8 Module.
.13 Allen Bradley 1492-AIFM8-3 Interface module for OF8C Module.
.14 Allen Bradley 1492-CAB010B69 Cable.
.15 Allen Bradley 1492-CAB025E69 Cable.
.16 Allen Bradley 1492-ACAB010EB69 Cable.
.17 Allen Bradley 1492-ACAB010D69 Cable.
.18 Allen Bradley 1492-CAB010A69 Cable.
.19 Allen Bradley 1492-1YCAA110 Circuit Breaker.
.20 Allen Bradley 1492-JG2Q Ground terminal block.
.21 Allen Bradley 1492-IFMFH1 Fuse Holder.
.22 Allen Bradley 1492-J3 Feed Through terminal block.

Miscellaneous Allen Bradley equipment:
.23 Allen Bradley 1606-XLS240E 240W 120VAC/24VDC Power supply.
.24 Allen Bradley Panel View Plus 6- 1500 HMI Touchless screen 15”.
.25 Allen Bradley 9300 RADES Modem.

Miscellaneous equipment:
.26 Eaton EX 1500 120V, 1500VA UPS.
.27 B&B ESW208 – 2ST Unmanaged Ethernet switch: 6 copper, 2 fiber (ST) Ports.

Part 3 Execution

3.1 LOCATIONS

.1 The location of the controller panels must be approved by the owner.

3.2 INSTALLATION

.1 Contractor shall execute the works in accordance with the Contract and to the satisfaction of the Engineer and comply with the Engineer's instructions on any matter thereto, whether referred to in the Contract or not.

.2 When job conditions require reasonable changes in locations and arrangements indicated, the Contractor shall make such changes without extra cost to the Owner. Contractor to allow for minor wiring changes on site during commissioning as instructed by engineer without additional cost to contract.

3.3 CONTROL PANELS

.1 The panel is to be built in accordance with the requirements of the CEC and UL (Canada) standards by an approved manufacturer and shall bear a recognized manufacturer nameplate.

.2 Rittal, Hammond, Armor, Hoffman and Bel are acceptable panel manufacturers, provided that the model offered bears a UL (Canada) or CSA label.

.3 All cabinets and enclosures to be restrained in a manner which meets the seismic requirements for the building.

3.4 WORKMANSHIP

.1 It is understood that this installation shall be made in a neat and workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, is not in compliance with the intent of good workmanship.

3.5 TEST

.1 All equipment shall be thoroughly tested for hardware problems and wiring errors prior to shipment.

3.6 WIRING

.1 All terminal blocks, fuses, mounting channel, etc., required. Each panel device is to be wired to a terminal strip. Panels are to be protected by a main interrupting device (fuse/breaker) on each 120 V supply.

.2 All control wire internal to the cabinets: AWG #16, 19-strand copper, extra-flexible machine tool wire, color-coded as follows:

Black – AC Power Line Voltage

White - AC Power Neutral Voltage

Red - Switch Leg on AC Power

Blue - 24 VDC Positive

Yellow - 24 VDC Common

.3 All shielded and twisted instrumentation wiring internal to the cabinet: Belden 8771 (3C AWG #22) and 8761 (2C AWG #22), all stranded copper conductors with 100% Beldfoil shield and AWG #22 copper drain wire.

.4 All wire labels: water and corrosion-resistant wire labels are to be used. Wires are to be identified at each end and at each terminal block with the terminal designation shown on the drawings.

.5 All digital field I/O wiring to be #16AWG. All analog field I/O wiring to be Belden cables.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 01 – Controls: General Requirements.

.2 Section 25 05 02 – Controls: Submittals and Review Process.

.3 Section 25 05 54 – Controls: Identification.

.4 Section 25 90 01 – Controls: Site Requirements, Applications and Systems Sequences of Operation.

1.2 REFERENCES

.1 National Electrical Manufacturer's Association (NEMA).

.1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 International Electrical Commission (IEC).

.1 IEC 60529, Classification of Degrees of Protection Provided by Enclosures (IP Code).

1.3 SUBMITTALS

.1 Submit shop drawings, technical sheets and manufacturer's installation instructions in accordance with Section 25 05 02 – Controls: Submittals and Review Process.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 Operating conditions: 0 – 40 degrees C with 10 – 90 % RH (non-condensing) unless otherwise specified.

.3 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.4 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.6 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.7 Range: including temperature, humidity, and pressure as indicated in Section 25 90 01 – Controls: Site Requirements, Applications and System Sequences of Operation.

.8 Control devices to satisfy the following requirements:

.1 Controls must react to changing conditions.

.2 Linearity: relationship between control device measurement (temperature, humidity, pressure, etc.) and output signal to be linear type.

.3 Control limits: control devices to maintain their controlled variable within the following set point limits:

.1 Temperature:

.1 ± 0.3°C (0.5°F) for chilled water and hot water systems.

.2 ± 0.8°C (1.5°F) in all other applications.

.2 Humidity:

.1 ± 5% in all cases.

.9 All control equipment and field devices provided under this section must meet or exceed the level of performance, the operational requirements and the fabrication characteristics of the equipment described in these specifications. Equipment with any variation from these specifications in terms of quality, performance, construction, operating sequences or system features must be reviewed and approved as an equivalent by the Consultant.

2.2 TEMPERATURE SENSOR - T

.1 General: resistance type to following requirements:

.1 RTD's: 1000 ohm or 10k ohm platinum element with strain minimizing construction and standard coefficient of resistivity.

.2 Sensing element: hermetically sealed.

.3 Unless otherwise noted, complete with ABS enclosure.

.4 Accuracy: plus or minus 0.2 degrees C.

.5 Room temperature sensor:

.1 Type: NTC 10k ohms, ± 0.2°C accuracy, standard resistance/ temperature coefficient, for a wall recessed installation.

.2 Stainless steel plate cover with tamperproof screws.

.3 Greystone no. TE-200.

.6 Duct temperature sensor:

.1 General purpose duct type: suitable for insertion into ducts at various orientations, probe length 460 mm or half of duct size at insertion point.

.2 Averaging duct type: incorporates numerous sensors inside a soft copper tubing which are averaged to provide one reading. Minimum probe length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.

.7 For use with Honeywell T775 Stand-alone controllers:

.1 PTC: 1,097 ohms at 25°C.

.2 Resistance: Current-loop type transmitter, 3-lead platinum RTD with standard coefficient of resistivity. 4-20 mA analog output.

.3 Sensing element: hermetically sealed.

.4 Stem and tip construction: copper or type 304 stainless steel.

.5 Time constant response: less than 3 seconds to temperature change of 10°C.

2.3 Electronic Stand-alone Controller - SAC

.1 General:

.1 Stand-alone digital controller, for panel mounting complete with graphical user-interface, lockable keypad, real-time internal clock and volatile memory.

.2 When used as a thermostat, complete with integrated space temperature sensor and NEMA-4X housing.

.3 The controller allows the configuration of inputs, outputs, integral and derivative time constants, value of reset setpoints and the calibration of sensors connected.

.4 Power requirements: 120 VAC, 60Hz.

.2 I/O requirements:

.1 (1) Analog Input accepting 1,097 ohms PTC type thermistor.

.2 (1) Universal Input, configurable for 0-5 Vdc, 0-10 Vdc or 4-20 mA.

.3 (2) Universal Outputs, configurable for 2-10 Vdc, 0-10 Vdc or 4-20 mA.

.4 (1) Digital Output.

.5 Relay Contact Outputs.

.6 As per T775 series from Honeywell.

2.4 Hot Water System Stand-alone Controller

.1 General :

.1 Provide and install a control system for automation of the hot water system.

.2 Fully autonomous control system consisting of a controller, an outdoor sensor, a supply and return temperature sensors, the wiring and all other accessories necessary for the proper operation of the system.

.2 Controller:

.1 Microprocessor-type controller specifically designed for the control of up to (3) modulating boilers and the pump systems, preprogrammed at the factory and complete with PID loops, alphanumeric display and numeric control keypad.

.2 The controller includes all inputs / outputs for the connection of devices and accessories and provides one contact for a remote alarm.

.3 Power requirements: 120 VAC, 60Hz.

.4 As per model Boiler Control 264 from Tekmar.

.3 Outdoor air sensor :

.1 10k ohm NTC thermistor outdoor temperature probe capable of operating in environmental conditions between -50 and 60 °C.

.2 Complete with PVC housing for outdoor installation.

.3 As per Model 070 from Tekmar

.4 Wiring:

.1 All wiring and connections necessary for start-up and operation of the control system shall be provided by the system supplier.

2.5 Electric Thermostat - TE

.1 Requirements:

.1 Operates and resets automatically.
.2 Adjustable set point and differential.
.3 Snap action rating: 120V, 15 amps. Switch to be DPST for hardwire connection.
.4 Type as follows:
.5 Room Thermostat (T): For heating stage only: as per Honeywell model T4051A or approved equivalent.

2.6 Flow Switch – FS

.1 Requirements:

.1 Free swinging vane with magnetically actuated switch design.
.2 Body material: Brass.
.3 Wetted materials: 316 SS.
.4 Pressure rating: maximum of 1,000 psi.
.5 Temperature rating: -20 to 135 degrees C.
.6 Set point Adjustment: vane combination.
.7 Switch: snap action type, rated at 120V AC, 10 amps.
.8 Switch assembly: to operate automatically and reset automatically when conditions return to normal.
.9 Electric components to be sealed in a separate NEMA-4 box.
.10 Conduit connection: ¾ female NPT.
.11 Process connection: 1 1/2 NPT-screwed.
.12 As per V4 Flotect series from Dwyer.

2.7 CURRENT SENSORS

.1 Current Relay - CR:

.1 Suitable to detect belt loss or motor failure.
.2 Trip point adjustment, output status LED.
.3 Amperage range: 1 – 135 A.
.4 Isolation: 600 V AC rms.
.5 Induced sensor power.
.6 Relay contacts: NO solid state. (1 A at 30 VAC / DC).
.7 Type H708 or H908 Hawkeye from Veris Industries.

2.8 ELECTROMECHANICAL RELAY - R

.1 Requirements:

.1 4PDT or DPDT, plug-in type with termination base and LED status indicators.
.2 Coils: rated for 120V AC or 24V DC.
.3 Contacts: rated at 10 amps at 120 V AC.

.4 In applications where relay is subject to vibration, provide hold-on clip.

.5 Type HC from Aromat or approved equivalent from Omron or Magnecraft.

2.9 TIMER RELAY – TR

.1 Requirements:

.1 Multifunction electronic relay, plug in type with termination base.

.2 Multi-voltage rating: 100 to 240 V A.C., 24 to 48 V A.C./D.C.

.3 Field selectable time range from .05 second to 300 hours (site adjustable).

.4 In applications where relay is subject to vibration, provide hold-on clip.

.5 Select the time range based on application.

.6 Configurable to operate as shown on drawing M-604.

.7 As per Omron no. H3CR-A.

2.10 LIMIT SWITCH – LS

.1 Heavy duty type limit switch complete with position indicator, sealed metal body and housing, and stainless steel adjustable lever with roller. Plug-in construction with IP67 NEMA 6P rating. NEMA A600, 600V, 10 amp continuous rating.

2.11 CONTROL PANEL – CP

.1 Cabinet type, complete with key-lockable front door mounted on concealed hinges, easily removable to provide interior access. Installed on rigid support for mounting on wall or pipe stand. Enclosure rating to NEMA-4X.

.2 Locate to provide a minimum clearance of 1000 mm (40") in front of panel.

.3 Accessories:

.1 All controls equipment including relays, switches, fuses, terminal blocks, etc., to be installed inside the panel.

.2 Push buttons, pilot lights, selector switches, filter pressure indicators, etc., to be surface mounted on the panel's front door.

.3 All wiring shall be inside raceways of adequate size with 40% of free space.

.4 Identification:

.1 Identify each device installed within the control panel using pre-printed electronically generated self-adhesive vinyl labels.

.2 Label all wiring and terminals inside the control panel. Identification to match wiring diagrams.

.5 Terminal blocks:

.1 All joints and connections inside the panel must be done on screw-type terminal blocks.

.2 Industrial grade modular type terminal blocks, DIN-rail mounted with vibration proof screw connections and color coded labelled terminals and voltage and current separators.

.3 Allow 15% (minimum 10 terminals) spare capacity per panel.

.4 As per SAK series from Weidmüller or approved equivalent.

.6 Provide a manual switch inside the panel for the 120V power supply.

.7 Supply and install on the interior of the panel's front door, a detailed schematic diagram of the system's arrangement, including all wiring and devices identification. Schematic drawing to be sealed in a transparent plastic case.

2.12 TRANSFORMER - TR

.1 Single phase transformer, enclosed type complete with fuse holder and fuse. Transformer capacity in VA to be at least 20% greater than the rated charge to be connected. Use of transformers with integrated thermal protection or with intrinsic limitation as an alternative to fuses is prohibited.

.2 As per MC series from Marcus or approved equivalent from Hammond.

.3 Note that the 120 V source must be separate (in a junction box or trough) from the 24 V relay panel.

2.13 CONTROL PANEL - ACCESORIES

.1 Pilot Light – PL:

.1 Heavy-duty, oil tight, LED type light indicator, for 24 V or 120 V supply, NEMA-4X enclosure rating, dimension: 16mm.

.2 Selector Switch – SS:

.1 Heavy duty, oil tight, maintained, 2 or 3 position labeled as indicated, NEMA-4X enclosure rating, rated for 120V.

.3 As per Square D series 9001, type XB6 or approved equivalent from Klockner-Moeller or Siemens.

2.14 ELECTRIC DAMPER ACTUATOR - ME

.1 Requirements:

.1 Electric or electronic type motor.

.2 Proportional or on/off type as indicated.

.3 Direct mount with U-bolt type clamp and anti-rotation bracket. Provide all additional mounting brackets, accessories or adaptors required for damper shaft coupling.

.4 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.

.5 Size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater. Torque requirements to be 50% greater than theoretical requirements.

.6 Operating range: 0-10 V or 4-20 mA.

.7 For fan interlocks: On/Off, 120VAC.

.8 As per Belimo, type NF or AF, or approved equivalent from Siemens, Johnson Controls or Honeywell.

.2 Combustion air damper:

.1 Fully opens in 15 seconds or less on spring-return.

2.15 MOTORIZED VALVE – MV

.1 General:

.1 Flow factor (CV) as indicated on control valve schedule.

.2 All motorized valves are equipped with a spring return for "fail-safe" operation. Normally Open or Normally Closed position as indicated.

.3 Size actuator to meet close-off pressure and control valve performance requirements. Actuator torque to be 25% greater than theoretical requirements.

.2 Butterfly Valve:

.1 Body: Lug Type, ANSI Class 150 cast iron.

.2 End connections: Flanges to ANSI Class 300.

.3 Disc: stainless steel with Nylon 11 coating.

.4 Seat: EPDM (ethylene propylene diene monomer).

.5 Stem: stainless steel.

.6 Maximum pressure rating: 175 psig.

.7 As per Bray Controls series 31, complete with electric actuator series 70, position indicator and manual override and an auxiliary switch indicating valve travel position.

.3 Ball Valve – ON/OFF application:

.1 Body: Full-port type, cast iron ANSI Class 300.

.2 End connections: flanged.

.3 Ball and stem: stainless steel.

.4 Seals: EPDM O-rings with Teflon seals.

.5 As per Bray SoftTouch Max Ball series, complete with On/Off electronic actuator (24VAC), position indicator with manual override and an auxiliary switch indicating valve position

.4 Ball Valve – Throttling application:

.1 Body: Full-port type, cast iron ANSI Class 300.

.2 End connections: flanged.

.3 Ball and stem: stainless steel.

.4 Seals: EPDM O-rings with Teflon seals.

.5 Equal percentage characteristics.

.6 As per Bray Flow-Tek 19 Series Segmented Ball Valve, complete with modulating electronic actuator (24VAC), position indicator with manual override and an auxiliary switch indicating valve positions.

2.16 UNINTERRUPTIVE POWER SUPPLY – UPS

.1 Controllers (PLCs), Human Machine Interface (HMI) and network components are connected to emergency power via an uninterruptible power supply.

.2 In addition, power supply management system can provide the following functions:

.1 Scheduled shutdown following a power failure, in order to close applications/software and allow data saving.

.2 Independent control of connected loads.

.3 System shutdown and restart based on a programmed schedule.

.4 Sequential start-up for components powered by the system.

.5 Restart sequentially component powered by the system.

.6 Regulated power supply.

.7 Monitor and trigger power supply alarms.

.8 Perform routine verifications of system, including batteries and generation of alarms in case of system failure or faults.

.3 The uninterruptible power supply unit shall be able to provide power to connected equipment for a minimum of 15 minutes. The unit has the following features:

.1 Power supply: 120 V A.C.

.2 Output: capacity to provide 15 minutes operation of connected equipment with extra capacity of 20% over the equipment load rating.

.3 On line double conversion type.

.4 Batteries can be replaced while the unit is operational.

.5 Line regulation: -10% to + 6%.

.6 Rechargeable acid/lead batteries, maintenance-free.

.7 Battery life expectancy: three to six years.

.8 Three years extended warranty on system and battery.

.9 As per APC Smart-UPS Online or approved equivalent.

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 datasheet.

3.2 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, controllers, relays: install in local control panels or separate NEMA I enclosures as required. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels on pipe stands or channel brackets.

.5 Fire stopping: provide space for fire stopping and maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Section 25 05 01 – Controls: General Requirements and Section 26 05 00 - Common Work Results for Electrical.

.2 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

3.3 TEMPERATURE SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Duct installations:

.1 Do not mount in dead air space.

.2 For installation on thermally insulated ductwork, mount devices on top of insulation using appropriate metal supports.

.3 Thermally isolate elements from brackets and supports to respond to air temperature only.

.4 Support sensor element separately from coils and filter racks using galvanized steel channels.

.4 Thermowells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.

.2 Thermowell to restrict flow by less than 30%.

.3 Use thermal conducting paste inside wells.

3.4 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.5 IDENTIFICATION

.1 Identify field devices in accordance with Section 25 05 54 – Controls: Identification.

3.6 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 05 01 – Controls: General Requirements.

END OF SECTION

PROJECT : 8015-072

CONTROL VALVE CHARACTERISTICS

(See specifications sub-section 25 30 02)

IDENTIFICATION	FLOW (usgpm)	CV	SIZE (in)	ACTUATOR	VALVE				WPD (psig)	QUANTITY	REMARKS
					TYPE	MODEL	N.O.	N.C.			
MV-HX1-1	152.0	72.0	4	MOD	2W		**X**		4.68	1	GLH
MV-HX1-2	200.0	-	6	ON/OFF	B		**X**		-	1	CHW
MV-HX1-1	152.00	72.0	4	MOD	2W		**X**		4.68	1	GLH
MV-HX1-2	200.00	-	6	ON/OFF	B		**X**		-	1	CHW
MV-WS	-	-	2	ON/OFF	2W			**X**		RD	CHW

NOTES:

PAP = POSITIONNER AIR PRESSURE
WPD = WATER PRESSURE DROP
N.O. = NORMALLY OPEN
N.C. = NORMALLY CLOSED
LS = LIMIT SWITCH
MOD = MODULATING
PW = PROCESS WATER

ON/OFF = 2 POSITIONS
HWT = HOT WATER TEMPERATURE
LWT = LOW WATER TEMPERATURE
CHW = CHILLED WATER
GLH = GLYCOL HEATING
GC = GLYCOL RUN AROUND
STM = STEAM

TYPES:
2W = TWO WAY
3W = THREE WAY
B = BUTTERFLY
3WT = THREE WAY MOUNTED ON A T
RD = REFER TO DRAWINGS FOR QUANTITY AND LOCATION
PICV = PRESSURE INDEPENDENT CONTROL VALVE

Part 1 General

1.1 PROGRAMMING

.1 The sequences, procedures and programs described in the part "EXECUTION" of this section represent the minimum operation criteria's, excluding the fine details required for tuning of the systems.

.2 All programming is to be completed by the Owner.

.3 Any modification, addition or refinements to operating sequences, as required or requested by the Engineer, to improve system stability or equipment protection, will be executed without additional costs.

1.2 CONFIGURATION AND CUSTOMIZATION

.1 System configuration and customization must be executed in collaboration with the Owner, in order to allow an easy transfer to operation team.

.2 Messages, descriptors, equipment keywords, etc., must be submitted for approval.

.3 Choice of colors, graphic layouts (displays), system breakdown, tree structure (level of intrusion) and graphic configuration must be done in coordination with the Owner.

.4 Creation of reports, headers, information displayed and its layout, printing frequency and periods, etc., are done in coordination with the Owner.

.5 Further to the dynamic graphic of each system, a dynamic architectural floorplan for each floor, showing the location of all thermostats.

Part 2 Product

2.1 NOT USED

.1 Not Used

Part 3 Execution

3.1 GENERAL

.1 Setpoints, parameters and constants:

.1 All setpoints, compensation rates and limits, calendars and schedules are adjustable by the operator, provided he has an authorization level. Similarly, all parameters, constants, programmed delays can be adjusted by an operator with the proper access authorization.

.2 Constants and control modes:

.1 All control loops shall be proportional and integral (PI) type except for flow and pressure control loops which shall be proportional, integral and derivative (PID) type and limit loops, which are proportional only.

.2 On-site, the operator must be able, without making programming modifications, to delete (or add) any type of control mode, modify constants or parameters, etc.

.3 Adjust all control loops in order to obtain a system that will provide a stable operation during extreme conditions, with minimum access time.

.4 Program filters to stabilize analog readings, more specifically on pressure and flow readings used in control loops.

.5 For each start-stop command, provide a minimum “On” and minimum “Off” time to eliminate cycling.

.3 Analytical data transfer:

.1 The data trending and analytical calculation strategy must ensure that the data transfer on the associated network is minimized as much as possible. Therefore, the result of a calculation, instead of the data required for the calculation, will be transmitted directly.

.4 Analog alarms:

.1 For each analog measurement point, program high and low limit alarms.

.2 Allow for the programming of four (4) alarm limits: two low-limits and two high-limits.

.3 Each of these alarm setpoint can be modified or supressed, as required by the operator.

.4 Unless otherwise noted, alarms originating from sensors located in a system duct (or piping) will be interlocked with their corresponding fan (or pump) in order to supress alarms when a system is not running.

.5 Critical alarms:

.1 When the status is available, program critical alarms for the following points:

.1 Unauthorized "on-off" for fans, pumps, etc.

.2 Freeze risk.

.3 High or Low pressure.

.4 Fault (equipment).

.5 Abnormal control state (level, pressure, temperature).

.6 Main electrical phase loss.

.6 Maintenance alarms:

.1 When the status is available, program maintenance alarms for the following points: System stopped, dirty filter, running time.

.2 When a status is available, provide cumulative running time of the equipment.

.7 Analog current transmitter analysis:

.1 For each analog current transmitter, provide real time consumption percentage of the associated motor or equipment by comparing the actual current reading with the full load current consumption.

.2 For all belt driven motor, remove the belts to measure the current with no load, then reinstall the belts. Alarm when the no load value is detected.

.8 Setpoint ramping:

.1 On system start-up or following a set point modification, an ascending (or descending) ramp must be implemented to increase (or decrease) progressively a set point towards its final value, thus preventing risks such as freezing, low-pressure, high-pressure, etc. Ramp rates must be adjustable.

.9 Starting after a power failure:

.1 Once power is restored, every electro-mechanical equipment (i.e. fans, pumps) is started in accordance with a predefine sequence to avoid a power overload and control peak demand. Provide a programmable start-up delay for each equipment controlled.

.10 Starting manually:

.1 Upon detection of a non-start signal or a non-authorized stop (manually commanded at the starter), a maintenance alarm is issued and the system is controlled as per the normal sequence of operation.

3.2 SEQUENCES OF OPERATION

.1 BOILER ROOM VENTILATION

(Ref.: Drawing M-602)

.1 At shutdown:

.1 Unit heaters (UH-01 to UH-04) are stopped.

.2 Fan F-01 is stopped.

.3 Dampers ATMD-OA and ATMD-EA are closed.

.4 Damper MD-RA is open.

.2 At start-up:

.1 The fan F-01 starts.

.2 Controls are operational.

.3 Normal operation:

.1 Room temperature sensor (RM-T1):

.1 The stand-alone controller (SAC-02 - T775) starts the ventilation fan F-01 when RM-T1 rises above 20°C (adjustable at the controller interface).

.2 Upon confirmation of F-01 operation, via a current relay (CR), the stand-alone controller modulates the motorized dampers (ATMD-OA, MD-RA and ATMD-EA) to maintain RM-T1 at its setpoint (20°C – adjustable at the controller interface).

.2 UH-01/UH-02:

.1 The electric thermostat TE-1 starts the unit heaters UH-01 and UH-02 the temperature falls below 10°C (adjustable at the thermostat).

.3 UH-03/UH-04:

.1 The electric thermostat TE-2 starts the unit heaters UH-03 and UH-04 the temperature falls below 10°C (adjustable at the thermostat).

.4 Operation during off-hours:

.1 The system operates as per normal operation.

.5 Power loss:

.1 System runs on emergency power.

.6 Fire detection:

.1 Not applicable.

.7 Protections:

.1 Not applicable.

.2 GENERATOR ROOM VENTILATION

(Ref.: Drawing M-602)

.1 At shutdown:

.1 Unit heaters (UH-05 and UH-06) are stopped.

.2 Generator is off:

.1 The normally closed contact C1 from the generator control panel energizes the combustion air damper actuator (ATMD-CA). ATMD-CA closes.

.3 Dampers ATMD-OA and ATMD-EA are closed.

.4 Dampers MD-RA1 and MD-RA2 are open.

.2 Normal operation:

.1 UH-5/UH-06:

.1 The electric thermostat TE-1 starts the unit heaters UH-05 and UH-06 the temperature falls below 10°C (adjustable at the thermostat).

.3 Power loss:

.1 The generator starts:

.1 The contact C1 opens and de-energize the combustion air damper actuator (ATMD-CA). AMTD-CA returns to its fail-safe position (open).

.2 Room temperature sensor (RM-T1):

.1 By interlock, via the relay contact R-1, the stand-alone controller (SAC-01 - T775) is signaled the generator is operating and modulates the motorized dampers (ATMD-OA, MD-RA1, MD-RA2 and ATMD-EA) to maintain RM-T1 at its 20°C adjustable at the controller interface).

.3 UH-5/UH-06:

.1 The unit heaters operate as per normal operation

.4 Fire detection:

.1 Not applicable.

.5 Protections:

.1 Not applicable.

.3 HEAT TRACE PANELS

(Ref.: Drawing M-603)

.1 The heat traces (HT-1 to HT-4) operate as per their integrated control.

.2 The MCU controller monitor the heat traces and alarm the operator upon fault detection.

.3 The operator can reset the alarm manually from the Human Machine Interface (HMI).

.4 HOT WATER SYSTEM

(Ref.: Drawing M-603)

.1 At shutdown:

.1 The boiler system is disabled:

.1 Boiler B-1, B-2 and B-3 are stopped.

.2 The pumping system P-1/P-2 is disabled:

.1 P-1 and P-2 are stopped.

.2 At start-up:

.1 The boiler controller (TEKMAR 265) enables hot water pumping system (P-1/P-2) is enabled:

.1 The pumping system starts the duty pump (P-1 or P-2).

.2 Controls are operational.

.3 Normal operation:

.1 The boiler controller (TEKMAR 265) enables the hot water pumping system (P-1/P-2) when the outdoor air temperature (OA-T) drops below 10°C (adjustable at the boiler controller).

.2 The pumping system is a fully integrated pump equipped with sensorless technology. Integrated controls perform pump speed control to provide optimal flow/pressure in the system, rotation of pumps based on runtime and starts of the standby pump in case of command failure.

.3 Hot water supply temperature (T-BHS):

.1 The boiler system integrated controller controls B-1, B-2 and B-2 in sequence to maintain T-BHS at its setpoint (93°C – adjustable at the boiler controller interface). Boilers lead/lag and sequencing is managed by the boiler controller.

.4 Operation during off-hours:

.1 The system operates as per normal operation.

.5 Power loss:

.1 System runs on emergency power.

.6 Fire detection:

.1 Not applicable.

.7 Protections:

.1 Not applicable.

.5 WATER PUMPING SYSTEM

(Ref.: Drawing M-603)

.1 At shutdown:

.1 Heat exchanger (HX-1) valve (MV-HX1-1) is closed.

.2 Heat exchanger (HX-2) valve (MV-HX2-1) is closed.

.3 Duty heat exchanger isolation control valve (MV-HX1-2 or MV-HX2-2) is open.

.4 Standby heat exchanger isolation control valve (MV-HX1-2 or MV-HX2-2) is closed.

.5 Pumps WS-1, WS-2 and WS-3 are stopped.

.6 By interlock, the normally closed control valve actuator MV-WS is energized. The valve opens.

.2 At start-up:

.1 The first duty pumps (WS-1/WS-2/WS-3) is started at low speed.

.2 By interlock with the pumps status, the control valve actuator MV-WS is de-energized. The valve closes on spring return.

.3 Controls are operational.

.3 Normal operation:

.1 Lake water supply temperature (TS):

.1 The Allen-Bradley PLC controller opens the duty heat exchanger isolation valve (MV-HX1-2/MV-HX2-2) and modulates is associated hot water valve (MV-HX1-1/MV-HX2-1) to maintain TS at 5°C.

.2 Every week, the Allen-Bradley PLC controller switches the duty controller to equalize runtime operation.

.3 During a switch, the controller first opens both isolation (MV-HX1-2/MV-HX2-2). Upon confirmation of the valves opening, via limit switches, the controller closes the standby heat exchanger isolation valve.

.2 Lake pumps (WS-1/WS-2/WS-3):

.1 The system is designed to perform with one pump redundancy. Lead/Lag operation and pumps start/stop is managed by the Allen-Bradley PLC controller.

.2 The number of pumps operating depends on the water reservoir level at Signal Hill. The Allen-Bradley master controller in Signal Hill communicates the number of pumps required to the Char Lake Allen-Bradley MCU controller through a communication cable.

.3 There are (3) level that are communicated:

.1 Reservoir high: run (1) pumps at low speed (1.6L/s – actual speed to be adjusted with the TAB specialist).

.2 Reservoir low: run (1) pump at high speed (6L/s – actual speed to be adjusted with the TAB specialist).

.3 Reservoir very low: run (2) pumps at high speed (12L/s – actual speed to be adjusted with the TAB specialist).

.4 Every week, the controller rotate the lead pump to equalize the runtime.

.4 Operation during off-hours:

.1 The system operates as per normal operation.

.5 Power loss:

.1 System runs on emergency power.

.6 Fire detection:

.1 Not applicable.

.7 Protections:

.8 Communication failure:

.1 Upon a communication failure with the Signal Hill controller detected by the Allen-Bradley PLC, the controller operates the lake pumping system with (1) pump at low speed (1.6L/s).

.9 PLC failure:

.1 PLC Watchdog timer:

.1 Every 2 minutes, a digital output from the Allen-Bradley PLC controller energize the timer relay TR1 for 1 second. The timer relays TR1 to operate as shown on controls drawing M-603. A PLC failure is detected as soon the timer relay TR1 is open, which will happen if the PLC digital output remains in the same states (ON or OFF) for more than 5 minutes.

.2 Upon failure of the Allen-Bradley PLC controller, the relay logic in control panel (CP-02) bypass the PLC command and operate (1) pump at low speed (1.6L/s). The PLC failure duty pump can be changed locally via the selector on CP-02 front.

.3 By interlock, the heat exchanger HX-1 controls valves (MV-HX1-1 and MV-HX1-2) actuators are de-energized.

.6 AUTO DIALER AD-01

(Ref.: Drawing M-603)

.1 Alarms:

.1 The following alarms are send to the auto dialer (AD-01):

.1 Fire alarm - by others.

.2 PLC failure - by interlock with control panel CP-02 (contact 2R-3).

.3 Generator ON – signal from Allen-Bradley PLC.

.4 Generator trouble/failure – signal from Allen-Bradley PLC.

.5 Building low temperature – signal from Allen-Bradley PLC when the temperature measured in either the generator room or the boiler room drops below 5°C (adjustable).

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Complete and operational electrical system as required by the drawings and as herein specified.

1.2 RELATED WORK

.1 Division 01 – General Requirements

.2 Division 03 – Concrete

.3 Division 05 – Metals

.4 Division 21 - Fire Suppression

.5 Division 22 – Plumbing

.6 Division 23 – Heating, Ventilating and Air Conditioning (HVAC)

.7 Division 25 – Integrated Automation

.8 Division 26 – Electrical

.9 Division 28 – Electronic Safety and Security

.10 Division 33 - Utilities

1.3 DRAWINGS AND SPECIFICATIONS

.1 The General Conditions, Supplementary Conditions and Division 01 are a part of this specification and shall apply to this Division.

.2 The intent of the drawings and specifications is to include all labour, products and services necessary for complete work, tested and ready for operation.

.3 Symbols used to represent various electrical devices often occupy more space on the drawing than the actual device does when installed. In such instances, do not scale locations of devices from electrical symbols. Install these devices with primary regard for usage of wall space, convenience of operation and grouping of devices.

.4 These specifications and the drawings and specifications of all other divisions shall be considered as an integral part of the accompanying drawings. Any item or subject omitted from either the specifications or the drawings but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.

.5 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.6 If discrepancies or omissions in the drawings or specifications are found, or if the intent or meaning is not clear, advise the Engineer for clarification before submitting tender.

.7 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.4 QUALITY ASSURANCES

.1 Codes, Rules, Permits & Fees

.1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this work.

.2 Comply with all rules of the following standards:

.1 Canadian Electrical Code, CSA Standard C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations and the applicable building codes.

.2 Government of Nunavut's Good Building Practices Guideline – SEC. Ed. Dec., 2005.

.3 Electrical and Electronic Manufacturer's Association of Canada (EEMAC).

.4 National Electrical Manufacturer's Association (NEMA).

.5 Underwriter's Laboratories Incorporated (ULI).

.6 Underwriters Laboratories of Canada (ULC).

.7 Institute of Electrical & Electronic Engineers (IEEE).

.8 Illuminating Engineering Society (IES).

.9 InterNational Electrical Testing Association Standard for Acceptance Testing Specifications for Electrical Power, Equipment & System ANSI/NETA/ATS-2013.

.3 Do Overhead Lines in accordance with CAN/CSA-C22.3 No. 1-06, Overhead Systems.

.4 Quality of work specified and/or shown on the drawings shall not be reduced by the foregoing requirements.

.5 Immediately after award of contract and prior to installation, verify location, arrangement and point of attachment for service and service entrance equipment with supply authority and inspection departments. Failure to do so will render this Division responsible for any corrections necessary without additional compensation.

.6 Give all required notices, submit drawings, obtain all permits, licenses and certificates and pay all fees required for this work.

.7 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Engineer.

.2 Standard of Workmanship:

.1 Execute all work in a competent manner and to present an acceptable appearance when completed.

.2 Employ a competent supervisor and a sufficient number of licensed tradesmen to complete the Work in the required time.

.3 Arrange and install products to fit properly into designated building spaces.

.4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.

1.5 SUBMITTALS

.1 Prior to delivery of any products to job site and sufficiently in advance of requirements to allow ample time for checking, submit shop drawings for review in accordance with Section 01 33 00 – Submittal Procedures. Submit shop drawings for all equipment as required in each section of this specification.

.2 Prior to submitting the shop drawings to the Engineer, the Contractor shall review the shop drawings to determine that the equipment complies with the requirements of the specifications and drawings.

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

Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other 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.

Adjustments made on shop drawings by the Engineer are not intended to change the contract price. If adjustments affect the value of the work state such in writing to the Engineer prior to proceeding with the Work.

.4 Manufacture of products shall conform to revised shop drawings.

.5 Keep one complete set of shop drawings at job site during construction.

1.6 RECORD DRAWINGS

.1 Refer to Section 01 77 00 – Closeout Procedures.

.2 Keep one (1) complete set of white prints at the site office, including all addenda, change orders, site instructions, clarifications and revisions for the purpose of record drawings. As the work on site proceeds, clearly record in Red Pencil all as-built conditions, which deviate from the original contract documents. Record drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

.3 Prior to substantial performance, certify, in writing, that the as-built record drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.

1.7 OPERATION AND MAINTENANCE MANUALS

.1 Operations and Maintenance Manuals are to be prepared in accordance with Section 017700 – Closeout Procedures.

1.8 PRODUCT HANDLING

.1 Use all means necessary to protect the products of this Division before, during and after installation and to protect products and installed work of all other trades.

.2 Immediately make good any damage by repair or replacement at no additional cost to the Owner and to the approval of the Engineer.

.3 Remove advertising labels from all electrical equipment. Do not remove identification or certification labels.

.4 Remove dirt, rubbish, grease, etc. resulting from this work from all surfaces, including the inside of all cabinets, equipment enclosures, panelboard tubs, etc.

1.9 GUARANTEE

.1 Furnish a written guarantee to the Owner prior to final contract payment, which will be in effect for one year from the date of final acceptance of the complete work. Replace or repair at no cost to the Owner any defective material or workmanship except where, in the opinion of the Engineer, such defects are due to the misuse or neglect by the Owner.

.2 This general guarantee shall not act as a waiver of any specified or special equipment guarantees, which cover a greater length of time.

Part 2 Products

2.1 SELECTED PRODUCTS AND EQUIVALENTS

.1 Products and materials provided shall be new and free from all defects. Defective products or materials will be rejected, regardless of previous inspections. The Contractor shall be responsible to remove and replace defective products at their expense, and shall be responsible for any resulting delays and associated expenses which result from defective products being rejected. Related materials shall be of the same manufacturer throughout the project.

2.2 ALTERNATIVE PRODUCTS

.1 Where product names and manufacturers are specified, substitutions must be approved by the Engineer. Failure to obtain approval from the Engineer will result in the alternative product being rejected, in which case the Contractor shall provide an approved product at no additional cost to the Owner.

.2 The Contractor shall assume full responsibility for ensuring that when providing alternative products or materials, all space, weight, connections, power and wiring requirements etc. are considered. Any costs incurred for additional components, changes to services, structural or space requirements, layouts and plans, etc. that may be necessary will be borne by the Contractor.

.3 Suppliers to submit all requests for alternative product approval to the Engineer. Submissions must be received by the Engineer not less than seven (7) working days prior to the close of tenders. Submissions received after the "Cut-Off' date will not be reviewed.

All submissions which are approved by the Engineer shall be identified as "Approved Alternatives" in an Addendum. Alternative products not listed in the Addendum will be rejected.

.4 Approval of an alternate is not intended to change the original specifications unless specifically stated in the addenda. The submitter is responsible for all costs incurred by other trades as well as his own, to install the product/system in accordance with the contract documents.

.5 All submissions to be provided with technical data and whatever pertinent information that may be required by the Engineer to evaluate equivalency to the specified product. The responsibility to provide sufficient technical data with respect to submissions will remain solely with those making the submission.

2.3 QUALITY OF PRODUCTS

.1 All products provided shall be CSA Approved, Canadian Underwriters' Laboratory approved where applicable, and new, unless otherwise specified.

.2 If products specified are not CSA approved, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval.

.3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Engineer.

.4 Verify with the Electrical Inspection Department the acceptability of any pre-wiring done outside the territory of Nunavut and ensure that a permit is acquired.

2.4 UNIFORMITY OF MANUFACTURE

.1 Unless otherwise specifically called for in the Specifications, uniformity of manufacture shall be maintained for similar products throughout the work.

2.5 PRODUCT FINISHES

.1 Finish all cabinets, panelboards, switchboards, equipment cabinets, cable trays, etc. in ANSI 61 grey enamel unless otherwise specified.

.2 Apply primer on all items, which are to be finished on the job.

.3 Touch up all damaged painted finishes with matching lacquer, or, if required by the Engineer, completely repaint damaged surface.

2.6 USE OF PRODUCTS DURING CONSTRUCTION

.1 Any equipment used for temporary or construction purposes shall be approved by the Engineer and in accordance with the General Conditions, "Use of Premises." Clean and restore to "as new" condition all equipment prior to the time of substantial completion.

.2 The warranty period shall not begin until the date of substantial performance of the work.

Part 3 Execution

3.1 SITE EXAMINATION

.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.

.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.

.3 Report to the Engineer any unsatisfactory conditions which may adversely affect the proper completion of this work.

3.2 DEMOLITION OF EXISTING FACILITIES

.1 All equipment shown to be removed shall be disconnected and returned to owner, as long as equipment is considered to be in good working condition.

.2 Wire and conduit removed shall be removed from the site by the contractor.

.3 All wires to be reused shall be properly terminated, marked and covers shall be applied to junction boxes where necessary.

.4 All branch circuit wiring and conduit not to be reused is to be removed back to the distribution panel.

.5 Contractor to ensure the continuity of all circuits outside each area of construction, when demolishing devices.

3.3 COORDINATION WITH OTHER DIVISIONS

.1 Examine the drawings and specifications of all divisions and become fully familiar with their work. Before commencing work, obtain a ruling from the Engineer if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.

.2 Lay out the work and equipment with due regard to architectural, structural and mechanical features. Architectural and structural drawings take precedence over electrical drawings regarding locations of walls, doors and equipment.

.3 Do not cut structural members without approval of the Engineer.

.4 Coordinate with all Division installing equipment and services, and ensure that there are no conflicts.

.5 Install anchors, bolts, pipe sleeves, hanger inserts, etc. in ample time to prevent delays.

.6 Examine previously constructed work and notify the Engineer of any conditions which prejudice the proper completion of this work. Commencement of this work without such notification shall constitute acceptance of other work.

3.4 LOCATION OF OUTLETS AND LUMINAIRES

.1 Electrical drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural, Process and Structural drawings.

.2 Outlet and equipment locations shown on the drawings are approximate. Locations may be revised up to 3 meters to suit construction and equipment arrangements without additional cost to the Owner, provided that the Contractor is notified prior to the installation of the outlets, or equipment.

.3 Maintain luminaire locations wherever possible. Notify the Engineer of conflicts with other services.

.4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.

3.5 SEPARATION OF SERVICES

.1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.

.2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

.3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Engineer and the ceiling installer, and approved clips or hangers are used.

3.6 EQUIPMENT IDENTIFICATION

.1 3 mm thick plastic lamicoid name plates, black face, white core, mechanically attached with self tapping screws, 9.5 mm high lettering, to be attached to the front face of the following equipment:

.1 Distribution Centres (Indicate designation, bus capacity, voltage)

.2 Starters, contactors, Disconnects (Designation, voltage, load controlled)

.3 Panelboard (Designation, voltage, Bus Capacity)

.4 Automatic transfer switch (designation, voltage, rating)

.5 Terminal cabinets and pull boxes (system, voltage)

.2 Provide neatly typed circuit directories in panelboards to indicate the area or equipment controlled by each branch circuit.

.3 All conductors shall be identifiable by coloured insulation and permanent markers at every terminal and accessible points throughout its entire run.

.4 Colour coding to be in accordance with the Canadian Electrical Code.

3.7 WIRING TO EQUIPMENT SUPPLIED BY OTHERS

.1 Equipment supplied by the Owner or under other Divisions will be moved to the installation site by others. However, the electrical connection to the equipment shall be done by this Division.

3.8 TESTING

.1 Refer to Section 26 05 02 – Testing, Verification and Commissioning and Training Electrical Systems.

3.9 SINGLE LINE DIAGRAM

.1 Provide and mount a framed as-built single line diagram to be located adjacent to the main electrical service equipment. Use a clear Plexiglas cover. The diagram shall be 914 mm x 600 mm minimum.

3.10 INSTRUCTIONS TO OWNER'S PERSONNEL

.1 Refer to Section 26 05 02 – Testing, Verification and Commissioning and Training Electrical Systems.

3.11 SEALING OF WALL AND FLOOR OPENINGS

.1 All conduit and cable entries through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade shall be sealed to prevent passage of moisture, dust, gasses, flame, or to maintain pressurization.

.2 Openings shall be sealed when all wiring entries shown on the drawings have been completed.

.3 Sealing material shall be fire resistant and shall not contain any compounds which will chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations to be sealed.

.4 Firestop material to be CSA approved providing a one (1) hour fire rating. Material to be applied by means of a caulking gun or trowelling in place and be equal to Thomas and Betts #FST or 3-M.

3.12 HOUSEKEEPING PADS

.1 All floor mounted electrical equipment installed by this Division shall be mounted on concrete housekeeping pads. Concrete pads to be in accordance with Division 03 – Concrete.

3.13 SLEEVES

.1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.

.2 For wall, partitions and ceilings the ends shall be flush with the finish on both sides but for floors they shall extend 4" above finished floor level.

.3 Locate and position sleeves exactly prior to construction of walls, floors.

.4 Failure to comply with the above requirements shall be remedied at this Division's expense.

3.14 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 1000 V instrument.

.3 Check resistance to ground before energizing.

.4 Carry out tests in presence of Site Electrical Inspector.

.5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.6 Submit test results for Engineer's review.

3.15 LOAD BALANCE

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.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.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This document supplements the requirements of Division 26.

.2 Refer to Section 26 05 00 – Common Work Results for Electrical.

1.2 PREPARATION

.1 Make available all pertinent contract documents, shop drawings, product data, and operation and maintenance data on hand during equipment starting process.

.2 The Contractor, his suppliers, and/or manufacturers shall submit the qualification and experience of testing personnel, and/or agencies conducting field testing, including evidence in support of their competence to the Engineer prior to anticipated start-up two (2) weeks.

.3 Restore to new condition all equipment which has been operated during the construction phase.

.4 Permanently mark all final settings in such a manner that they cannot be eradicated or obliterated in any way.

.5 Verify the implementation of all identification procedures as specified in the Contract Documents.

.6 Identify systems which require testing after the facility has been handed over, accepted, and during the warranty period.

1.3 CORRECTION OF DEFICIENCIES

.1 Correct all contract deficiencies found during commissioning.

1.4 COMMISSIONING OF SYSTEM AND COMPONENTS

.1 Commissioning of components and systems will not commence until all systems have been demonstrated to function in accordance with the contract documents.

.2 Satisfactory completion of the work and demonstration that the requirements of commissioning are satisfied is the responsibility of the Contractor. Employ and pay for any specialist supervision, inspection and testing as required to complete the work.

1.5 COMMISSIONING PROCESS

.1 The Commissioning process consists of:

.1 Demonstrating proper operation of systems and components installed as part of the work defined in the Contract Documents.

.2 Integrated systems testing and fine-tuning.

.3 Preparation of materials necessary for training and instruction.

.4 Training and instruction of operations staff.

.2 Employ all resources, services, measures and responsibilities to execute the entire commissioning package without damage to systems or components.

.3 Employ qualified personnel to properly test demonstrate and report on all components, sub-systems, systems and integrated systems.

1.6 RESPONSIBILITIES

.1 The Contractor is responsible for organizing and implementing all aspects of the testing and commissioning process outlined herein.

1.7 SCHEDULES

.1 Prepare schedules describing all activities.

.2 Include dates the activities are to be carried out.

.3 Submit at least two (2) weeks prior to intended start-up.

1.8 COORDINATION

.1 Co-ordinate all sub-trades, other Divisions, manufacturers, suppliers, and other specialists as required to ensure all phases of work shall be properly organized prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.

.2 Co-ordinate the activities outlined herein with the starting and testing of:

.1 Water Pumping System and controls.

.2 Mechanical components and systems specified in Division 23.

.3 Electrical components and systems specified in Division 26.

.3 Where any components or systems require testing prior to starting, ensure that such work has been completed and approved prior to starting of these components and systems. Refer to Part 2 – Test/Verify and Testing Specifications in the relevant specification section.

1.9 TESTING OVERVIEW

.1 Ensure integrated system operations conform to design documents providing required performance with proper interaction between related systems.

.2 Verify performance of components and systems operating in conjunction with one another under all conditions and modes of operation. Each system is to be operated for as long as required to complete testing, commissioning and training.

.3 Reported results of testing and procedures are checked and verified to be correct within stated tolerances. If inconsistencies appear between reported results and demonstrated values, the relevant testing procedures are repeated and adjustments made until satisfactory results are obtained.

1.10 TESTING INSTRUMENTS

.1 Provide two-way radios, ladders and other equipment as required to complete system and component commissioning.

.2 Provide all safety equipment required for personnel involved in the starting, testing, adjusting, and balancing program.

1.11 TESTING PERSONNEL

.1 Provide sufficient 'qualified' personnel at field locations to successfully test and commission components, systems, and integrated systems.

1.12 FINE TUNING

.1 Modify operating parameters of the systems to satisfy the fine tuning requirements outlined by the Engineer so to ensure proper system operation. For example:

.1 Make adjustments which may become apparent as testing proceeds.

.2 Undertake modifications to suit changes as equipment settles down during the running in period.

.3 Documentation of results.

.4 Diagnosis of problems.

.5 Correct contract deficiencies previously outstanding as well as any identified during systems and integrated systems testing and fine tuning.

.6 Fine tuning will provide for the adjustment of the system where the integrated systems testing have shown a need.

1.13 MAINTENANCE OF EQUIPMENT AND SERVICE CALL-BACKS

.1 Maintain equipment and provide equipment service call-backs.

Part 2 Test/Verify Systems

2.1 EMERGENCY POWER SYSTEM

.1 Emergency Generator

.1 Verify field performance testing and records are complete.

.2 Verify vibration testing is complete and satisfactory and results recorded.

.3 Check and verify finishes are intact.

.4 Verify all data sheets completed and incorporated in manual.

.5 Verify all components tested and accepted.

.2 120/208 Volt Main Generator Breaker/Control Panel

.1 Verify relevant data sheets completed.

.2 Check and verify finishes are intact.

.3 Verify interior clean and dust free.

.4 Verify conduit and cable connections are correct.

.5 Verify cables in interior are properly trained and supported.

.6 Verify main breaker settings with engine/alternator supplier - receive written confirmation that settings are correct - and included in manuals.

.7 Verify metering at control panel

.1 meter is calibrated and programming correctly completed.

.2 verify that auxiliary inputs and outputs are correct and ready for demonstration and instruction.

.3 provide check list indicating each item verified.

.3 Transfer Switch

.1 Verify relevant data sheets completed.

.2 Verify transfer switch operation.

.3 Identify, set, confirm, record - all timer settings.

.4 Verify remote status outputs.

.5 Verify input and output signals to initiate generator start.

.6 Verify cable sheath and raceway connections are correct.

.7 Verify conductor terminations are correct and properly torqued.

.8 Verify finishes are intact.

.9 Verify interior is clean.

.10 Verify transfer switch operating time sequencing.

.11 Verify open transition time delay and record.

.4 Room Ventilation

.1 Confirm data sheets completed.

.2 Confirm operation of dampers/damper motors in accordance with control sequence.

.3 Confirm fan and control operation.

.5 Fuel Monitoring/Control System

.1 Verify relevant data sheets completed.

.2 Verify fuel tank level controls operating correctly – verify controller outputs and record.

.3 Verify fuel pump.

.6 Battery and Battery Charging.

.1 Verify relevant data sheets completed.

.2 Verify charger and status monitoring.

.3 Verify status outputs.

.7 Carry out total integrated system testing.

.1 Test actual power failure and auto start for transfer switch input/output.

.2 For failure confirm operation of all auxiliary systems; confirm operation of all status indication and metering.

2.2 MAIN SERVICE PROTECTION AND METERING

.1 Verify all data sheets completed.

.2 Verify finishes are intact.

.3 Review and confirm settings of main breaker.

.4 Check and verify cable sheath and raceway connections are correct.

.5 Check and verify that phase and neutral conductor terminations are correct and properly torqued.

.6 Check and verify phase rotation.

2.3 GROUNDING

.1 Check and verify ground plates and conductors properly installed.

.2 Check and verify ground bus is intact, properly supported and fastened.

.3 Check and verify all ground conductor terminations are correct and properly torqued – list item checked.

.4 Confirm building ground resistance measurements.

2.4 EMERGENCY LIGHTING UNIT – BATTERY OPERATED

.1 Verify information is complete and accurate in manual.

.2 Simulate failure by disconnecting power - check all leads and verify.

.3 Operate push to test switch - verify operation.

2.5 PANELBOARDS

.1 Check and verify finishes are intact.

.2 Check and verify interior is clean.

.3 Check and verify terminations are correct and properly torqued and conductors in wiring spaces are properly laced.

.4 Check and verify cable sheath and raceway connections are correct.

.5 Check and verify phase rotation.

.6 Check breaker operation - operate breaker - on and off.

2.6 DISCONNECT SWITCHES

.1 Check and verify finishes are intact.

.2 Check and verify interior is clean.

.3 Check and verify conductor terminations are correct and properly torqued.

.4 Check and verify cable sheath and raceway connections.

.5 Check and verify operation; operate switch.

.6 Check door/switch interlock.

2.7 ELECTRIC HEATING

.1 Check and verify finishes are intact.

.2 Verify connections are correct.

.3 Verify fan and heating element operation.

.4 Verify thermostat operation.

.5 Verify circuit protection

2.8 ELECTRICAL SYSTEM INSULATION

.1 Verify insulation resistance tests are completed.

.2 Verify data sheets completed.

2.9 PUMP CONTROLS

.1 Pump control panels and pumps.

.1 Inspect all power and control connections. Check for tightness and verify.

.2 Check and verify identification of all terminals and control conductors.

.3 Check and verify identification and arrangement of all components. Check against Bill of Materials and Drawings.

.4 Check operation of pump start controls in all positions; include:

.1 manual for pump control sequence

.2 auto alternate for pump control sequence

.5 Check rotation of pumps.

.6 Check and verify VSD operation; set timers.

.7 Verify internal thermal protection and monitor system thermal, leakage (Minicas)

.8 Verify overload relay and motor circuit protection settings. List each item verified.

.9 Verify operation of all contactors and relays. List each item verified.

.10 Check and verify operation of elapsed timers.

.11 Ensure verification check lists completed for each component and subassembly.

.2 Ultrasonic Level Transmitter

.1 Program the multi-ranger controller input set points - record.

.2 Verify operation of sensor.

.3 Verify level against sensor signals. Record actual operating and alarm points.

2.10 SECURITY

.1 Verify operation of:

.1 Door contacts.

.2 Smoke and fire detectors.

2.11 CONTROLS AND TELEMETERING

.1 Verify all status and alarm inputs at the control panel terminals. Provide check list and certify.

.2 Check and verify cell phone auto dialer for remote alarm signaling.

.3 After all testing and verification is complete, demonstrate all operating modes, sequencing, status and alarm indicators to users.

.4 Review each operating mode and each set point and demonstrate the operation to the user.

Part 3 Training

3.1 SYSTEMS DEMONSTRATION AND TRAINING

.1 Provide system demonstration and training.

.2 Training shall be conducted weekdays between 8:30 - 11:30 and 13:00 - 16:00, or as required to meet operational requirements.

.3 Provide instruction and training sessions on all equipment and systems to demonstrate the complete operation, function, care and maintenance of equipment and materials to the Owner, Engineer's designated personnel.

.4 Provide operations and maintenance documentation in accordance with Section 26 05 00 – General Instructions for Electrical. Include complete description of operation, function, care and maintenance of equipment and materials.

3.2 INSTRUCTIONAL SEMINARS

.1 Provide instructional seminars and training sessions including the following:

.1 Equipment and Systems:

.1 Contractor shall present information dealing with systems and equipment. Include the following:

.1 Explanation of how system(s) operate.

.2 Description of each specific subsystem or component operation and relevance in the overall system.

.3 Recommended preventative and routine maintenance.

.2 Conditions for Demonstrations:

.1 Equipment has been inspected and put into operation.

.2 Testing, adjusting and balancing has been performed in accordance with the requirements of Divisions 23 and 26. Equipment and systems must be fully operational.

.3 Provide copies of pertinent operation and maintenance manuals for use in demonstrations and instructions.

.3 Preparation:

.1 Verify that conditions for demonstration and instructions comply with requirements.

.2 Verify that designated personnel are present.

.4 Demonstration and Instructions:

.1 Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, scheduled and preventative maintenance, and shutdown of each item of equipment at agreed upon times, at the equipment location.

.2 Instruct designated personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.3 Review contents of manual in detail to explain all aspects of operation and maintenance.

.4 Prepare and insert additional data in operation and maintenance manuals when the need for additional data becomes apparent during instructions.

3.3 SEMINAR AND DEMONSTRATION QUESTIONS

.1 During demonstrations and seminars be prepared to answer all questions raised by the User/Operations personnel.

.2 If unable to provide satisfactory response to questions, provide written response within three (3) working days

3.4 COMMISSIONING MANUAL

.1 Compile test reports, verification forms, and certificates, by Division and specification section, into one Commissioning Manual.

.2 Submit to the Engineer for review, two (2) copies of draft manual two (2) weeks prior to application of Interim Certificate of Completion for the project.

.3 Submit four (4) copies of the approved manual prior to Interim Certificate of Completion.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

.1 Section 26 05 21 – Wires and Cables (0-1000 V)

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CAN/CSA-C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .2 CSA C22.2No.65-13, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

- .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

- .1 Connector body and stud clamp for stranded round copper conductors.
- .2 Clamp for stranded round copper conductors.
- .3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable, flexible conduit, as required to: CAN/CSA-C22.2No.18.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

.4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Provide a complete system of wiring, making all connections necessary for the installation shown on drawings.

1.2 REFERENCES, CODES AND STANDARDS

.1 CSA C22.2 No. 0.3-09 (R2014), Test Methods for Electrical Wires and Cables.

.2 Install and rate cables in accordance with the Canadian Electrical Code requirements, or in accordance with ICEA requirements where permissible.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 8 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene (XLPE) material rated RW90.

2.2 TECK CABLE

.1 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.2 Insulation:

.1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.

.3 Inner jacket: polyvinyl chloride material.

.4 Armour: interlocking galvanized steel or aluminum.

.5 Overall covering: Thermoplastic polyvinyl chloride material

.6 Fastenings and supports. Refer to Section 26 05 29 – Hangers and Supports for Electrical Systems.

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 6 mm dia. threaded rods to support suspended channels and cable trays.

.7 Connectors:

.1 Watertight or explosion proof depending on location, approved for TECK cable.

2.3 CONTROL CABLES

.1 Type LVT: soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket

2.4 LUMINAIRE WIRE

.1 Type TEW: Copper conductors, #12 AWG, with thermoplastic and asbestos insulation, flame retardant, heat and moisture resistant, rated 600 Volts, 105°C.

Part 3 Execution

3.1 GENERAL

.1 Minimum conductor size #12 AWG.

3.2 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 - Conduit Fastenings and Conduit Fittings.

.2 Overhead service conductors in accordance with Section 33 71 73.01 – Overhead Electrical Service.

3.3 INSTALLATION OF TECK CABLE 0 -1000 V

.1 Install cables with watertight or explosion proof sealable glands to suit the area of installation.

.2 Group cables wherever possible on channels.

.3 Terminate cables in accordance with Section 26 05 20 Wire and Box Connectors 0 – 1000 V.

3.4 WORKMANSHIP

.1 Before pulling wire, ensure conduit is dry and clean. If moisture is present, thoroughly dry out conduits; vacuum if necessary. To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease. Employ suitable techniques to prevent damage to wire when ambient temperature is below the minimum permitted for each insulation type. Do not pull wires into incomplete conduit runs.

.2 Installation to be free of opens and grounds. Before energization, measure insulation resistance and comply with the Canadian Electrical Code. Submit data sheet with values measured.

.3 Do not install any conductor smaller than #12 AWG, except where specifically indicated otherwise, i.e. for fire alarm system station circuits, P.A. wiring, etc.

.4 Provide sizes of conductors as shown on drawings. Voltage drop from lighting panels to farthest outlet must not exceed 2% at full load in any case. Advise Engineer if problem is foreseen.

.5 Exercise care in stripping insulation from wire. Do not nick conductors.

3.5 IDENTIFICATION, CODING AND BALANCING

.1 For branch circuit wiring, follow identification system shown on the drawings and as specified in Section 26 05 00 – Common Work Results for Electrical.

.2 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting shown as required for optimum balancing. Record all changes on "record" drawings.

.3 Colour code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc. Use two wraps of 3M #471 plastic film tape 48 mm wide.

.4 Conductors sized No. 2 AWG and smaller are required to be factory coloured, not taped on site.

.5 For direct current wiring use red for positive and black for negative.

3.6 TESTING

.1 All power and control wiring shall be tested for insulation resistance value with a 1000 volt megger. Resistance values shall be as recommended by the cable manufacturer.

.2 All wire test results shall be properly tabulated, signed, dated, and submitted to the Engineer.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837-2014, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International)

.3 CAN/CSA Z32-09 (R2014), Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Plate electrodes: copper, surface area 0.2 m^2, 1.6 mm thick.

.3 Grounding conductors not in raceway: bare, stranded copper, tinned, soft annealed, size as indicated.

.4 Insulated grounding conductors in raceway: green, type TW or RW90.

.5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.6 Non-corroding accessories necessary for grounding system, type, copper, size, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Bonding jumpers, straps.

.5 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run insulated ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, electrodes, using permanent copper mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at both to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Make grounding connections in radial configuration only, with connections at equipment terminating at single grounding point. Avoid loop connections.

3.2 ELECTRODES

.1 Install plate electrodes and make grounding connections.

.2 Bond separate, multiple electrodes together.

.3 Use size 2/0 AWG copper conductors for connections to electrodes.

.4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of secondary 120/240V, 1-phase system at the service point.

3.4 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, duct systems, frames of motors, motor starters, control panels, building steel work, generators, distribution panels, outdoor lighting.

3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall adjacent the main electrical service.

.2 Ground items of electrical equipment in electrical room to ground bus with individual TW75 #6 AWG.

3.6 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

.2 Sound, fire alarm, intercommunication systems as indicated.

3.7 GROUNDING AND BONDING INSTALLATION

.1 Bond non-current carrying metal parts together with size #6 AWG copper equipotential conductor. Run conductor from separate lug or service neutral bar to, but not necessarily limited to, following indoor systems and equipment:

.1 Hot water heating system.

.2 Main water pipe.

.3 Main building drain.

.4 Oil line.

.5 Telephone, radio/tv, emergency and fire alarm lead-in or service conduits, near panels.

.6 Make connections to pipes on building side of main valves and tanks. Connect jumpers across boilers to supply and return hot water heating pipes.

.2 Install ground wire from service neutral bar to rods and where buried use bare copper not smaller than size 1AWG7- strand or size 4AWG solid, and at least 460 mm below ground. Bond ground conductor, or short tap from it, to outside metal sheathing of building close to power service conduit. Use lug or cast clamp, with bronze or plated bolt, nut and washers (not sheet metal screw or wood screw). Remove paint from sheathing for good contact. Conduit is required only on outside wall of building. Indoors, run bare and fasten as specified for equipotential bonding wire.

3.8 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 – Testing, Verification, Commissioning and Training Electrical Systems.

.2 Perform ground continuity and resistance tests using 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 WORK INCLUDED

.1 Supply and install all hangers, supports and inserts for the installation shown on the drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Product

2.1 FRAMING AND SUPPORT SYSTEM

.1 Materials:

.1 Intermediate duty supporting structures shall employ P1000 Unistrut or equal together with the manufactures connecting components and fasteners for a complete system.

.2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.

.2 Finishes:

.1 Outdoors, wet locations: Hot dipped galvanized.

.2 Indoors, dry locations: Galvanized when available, prime painted if not available.

.3 Nuts, bolts, machine screws: Cadmium plated.

.3 Unistrut:

.1 Section P1000 or as required for load and span, with mounting screws, or approved. P1000 or equal is a minimum standard for supporting conduits 50 mm and larger.

2.2 CABLE TRAYS

.1 Class C1 aluminum with suspension supports as necessary for cable loading.

2.3 CONCRETE AND MASONRY ANCHORS

.1 Materials: Hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.

.3 Manufacturer: Hilti (Canada) Limited or approved equal.

2.4 NON-METALLIC ANCHORS

.1 Material: Plastic anchors for sheet metal screws.

.2 Manufacturer: Fischer.

2.5 CONDUIT SUPPORTS

.1 Masonry, concrete, stone, etc.: Anchors.

.2 Metal studs, ceiling hangers, etc.: "Caddy-Clips"

.3 Unistrut: Unistrut conduit clamps.

2.6 THREADED STEEL ROD

.1 For suspension tray and multiple conduits.

Part 3 Execution

3.1 GENERAL

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Engineer is obtained.

.2 Distance between conduit or cable supports not to exceed code requirements.

.3 Supports to be suitable for the real loads imposed by equipment.

.4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 meter span and 8 mm over a 2 meter span.

.5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.6 Provide conduit rack with 25% spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 INSTALLATION

.1 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.2 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or 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.

.3 Suspended support systems.

.1 Support two (2) or more conduits or cable trays on channels supported by 6 mm dia threaded rod hangers.

.4 Use plastic anchors for light loads only. Use metal anchors for all other loads.

.5 Use round or pan head screws for fastening straps, boxes, etc.

.6 Do not support heavy loads from the bottom chord of open web steel joists.

.7 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four 6 mm fasteners.

.8 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Engineer.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Provide a complete system of splitters boxes and cabinets for the installation of wiring and equipment.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 00 – Common Work Results for Electrical.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 JUNCTION BOXES AND PULL BOXES, WEATHERPROOF

.1 Materials:

.1 Cast steel, Crouse Hinds, WBJ Series.

2.2 JUNCTION BOXES AND PULL BOXES, INDOOR DRY LOCATIONS

.1 Materials:

.1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.

.2 Components:

.1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.

.2 Use rolled edges for surface boxes.

.3 Junction boxes mounted in exterior walls shall be complete with box vapour barriers.

Part 3 Execution

3.1 INSTALLATION

.1 Junction Boxes and Pull Boxes:

.1 Supply all pull boxes and junction boxes shown on the drawings or required for the installation.

.2 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.

.3 Identify with system name and circuit designation as applicable.

.4 Size in accordance with the Canadian Electrical Code, as a minimum.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Provide a complete system of boxes for the installation of wiring and equipment.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer

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 FOR METAL CONDUIT

.1 Materials:

.1 Surface or recessed concealed type: Die formed steel, hot dip galvanized.

.2 Surface mounting exposed: Cast ferrous for threaded conduit, with attached lugs, corrosion resistant two coats finish.

.2 Outlet boxes surface mounting and concealed.

.1 Wall outlets concealed 101 mm of 119 mm square as required, depth to suit. Standard of acceptance Iberville.

.2 Wall outlets, surface, exposed mounting or used for outdoor outlets: One or more gang, Crouse-Hinds FS series or FD series.

2.3 CONDUIT BOXES

.1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

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 nun of opening.

.4 Provide correct size of openings in boxes for conduit connections. Reducing washers are not allowed.

.5 Install all outlets flush and surface mounted as required for the installation.

.6 Surface mount above suspended ceilings, or in unfinished areas.

.7 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

.8 Do not use sectional boxes.

.9 Provide boxes sized as required by the Canadian Electrical Code.

.10 Install vapour barrier material to surround and seal all outlet boxes located on exterior walls of building. Maintain wall insulation.

.11 Ceiling outlet boxes shall be provided for every surface mounted fixture or row of fixtures installed on suspended "hard" ceilings.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Provide a complete system of conduit and fittings for installation of wiring.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer

Part 2 Products

2.1 RIGID STEEL CONDUIT

.1 Galvanized with threaded joints and connections.

.2 Connections in dry locations: steel or malleable iron locknuts inside and outside enclosures. Insulated bushings standard of acceptance: Thomas & Betts Series 222.

.3 Connectors subjected to moisture interior and exterior: liquid and dust tight with insulated throat, standard of acceptance: Thomas & Betts "Bullet Hub" 370 Series.

.4 Fittings: cast metal standard of acceptance: Crouse-Hinds Canada Ltd. including gasketted covers in damp locations.

.5 Expansion joints: cast metal standard of acceptance: Crouse-Hinds Type XJ.

2.2 ELECTRICAL METALLIC TUBING (E.M.T)

.1 Fittings in dry locations: Steel or zinc set screw connectors with insulated throat. Steel or zinc set screw couplings.

.2 Fittings in wet locations: steel rain-tite connectors with insulated throat. Steel rain tite couplings.

2.3 RIGID PVC CONDUIT

.1 Ducts: Rigid non-metallic conduit of unplasticized polyvinyl chloride Type DB-2, conforming to CSA Standard: standard of acceptance SCEPTRE.

2.4 LIQUID-TIGHT FLEXIBLE CONDUIT

.1 Conduits: flexible metal conduit with liquid-tight PVC jacket.

.2 Connectors: captive sealing jacket and ground cone insulated throat, steel standard of acceptance: Thomas & Betts Ltd. "Super-Tight", Series 6000.

2.5 ZINC FITTINGS

.1 Connectors and couplings to be manufactured of No. 3A alloy conforming to ASTM designation B.240.

Part 3 Execution

3.1 RIGID STEEL CONDUIT

.1 Use as raceways for following applications:

.1 In all areas exposed to weather.

.2 Locations where mechanical damage may occur and in all rooms to a height of 1 metre.

.3 In all hazardous areas requiring explosion proof wiring methods.

3.2 ELECTRICAL METALLIC TUBING (E.M.T)

.1 Use as raceways for following applications:

.1 In dry non-hazardous areas above one (1) meter including concealed locations.

.2 It may not be used in damp locations, corrosive atmosphere, underground, outdoors, nor in areas exposed to mechanical damage.

3.3 RIGID P.V.C. CONDUIT

.1 Use as raceways for following applications

.1 In poured concrete floors and walls and on underground runs exterior to the buildings unless otherwise noted.

.2 Wiring installed in areas subject to intermittent or continuous moisture but not surface mounted.

.3 Rigid PVC conduit shall not be surface mounted.

.2 Provide insulated ground wire in all rigid PVC conduits in accordance with the Canadian Electrical Code.

.3 Where rigid PVC conduit is set in poured concrete, solvent joints must be completed and allowed to set as per manufacturer's instructions.

.4 Bend rigid conduit in strict accordance with manufacturer's directions. Distorted bends will not be accepted.

3.4 LIQUID-TIGHT FLEXIBLE CONDUIT

.1 Use as raceways for following applications:

.1 At all motors, pipe mounted control devices, and other devices subject to movement or water.

.2 At all motors; provide a short length before connecting to the motor terminal box. Minimum length shall be 450 mm plus 4 times the conduit diameter.

.3 Provide a separate ground wire within flexible conduit, bonded to motor frames and system ground.

3.5 WORKMANSHIP

.1 Install all conduit and wiring concealed, unless otherwise shown on the drawings. Do not recess conduit in columns, except as noted, without permission.

.2 Where conduit is run exposed, run parallel to building lines. Where conduits are grouped (two or more), space evenly, 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 from steam or hot water piping, vents, etc.

.4 Slabs on grade: Install rigid PVC conduit 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 Polykin #940 tape. Extend taping 300 mm above finished grade.

.5 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.

.6 Organize conduit in slabs to minimize crossovers. Obtain approval and minimum concrete cover required from structural engineer prior to installing conduits in slabs.

.7 Provide Brady underground warning tapes 300 mm below grade above all underground conduits. Tape shall be yellow warning tape, 150 mm wide.

.8 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. The first 3 meter length of conduit extending from the structure to be Polykin wrapped rigid steel.

.9 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. Stub-ups shall be rigid steel.

.10 Where steel conduit is required to be bent, do not heat, and do not bend conduit in such a way as to reduce pipe cross section area at any point. Radii of bends shall be as per Canadian Electrical Code.

.11 For all runs of conduits, do not include more than equivalent of 4 - quarter bends. Provide conduit fittings, pullboxes and junction boxes where necessary. Pulling elbows shall not be used except by special permission.

.12 Where possible, install conduits so that they are not trapped, cap turned up conduits to prevent the entrance of dirt of moisture during construction. Swab out conduit and thoroughly clean internally before wires and cables are pulled.

.13 Take extreme care in reaming ends of all conduit to ensure a smooth interior finish that will not damage the insulation of the wires.

.14 Use insulated non-metallic bushings on all conduit terminations 25mm and larger.

.15 Ensure electrical continuity in all conduit systems.

.16 Install a 90 lb. test line in all conduits left empty by this contractor including those which others will pull cables, wires, etc.

.17 Conduits and ducts crossing building expansion joints shall have conduit expansion fittings to suit the type of conduit used, and shall be Crouse-Hinds, Sceptre, or approved fitting.

.18 Seal conduits with duct seal where conduits are run between heated and unheated areas. Where conduits, cables, or cable trays pierce fire separations, seal openings with Dow Corning 3-6548 sealant or approved equal.

.19 Where drawings show cable designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels.

.20 Where conduit finish is damaged, repair or replace.

.21 All branch circuit wiring, home-runs, communication and data to be minimum 20 mm diameter unless otherwise stated.

.22 Provide necessary flashing and pitch pockets, making watertight joints where conduits pass through roof or watertight membranes.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 PHOTOELECTRIC LIGHTING CONTROL

.1 Exterior wall mounting.

.2 Capable of switching lighting as indicated on drawings.

.3 Voltage variation: plus or minus 10%.

.4 Temperature range: minus 40°C to plus 40°C.

.5 Rated for 5000 operations.

.6 Options:

.1 Fail-safe circuit completed when relay de-energized

.2 Twist-lock type receptacle

.3 Terminal strip.

.7 Switching time delay of 30 s.

.8 Wall mounting bracket.

.9 Colour coded leads: size 10 AWG, 460 mm long.

2.2 LIGHTING CONTACTOR

.1 Rated for inductive lighting load.

.2 No. of poles and current rating as indicated on the drawings.

.3 120 volt coil and control circuit.

.4 250 volt contactor.

.5 EEMAC 12 enclosure.

.6 3-position (H.O.A. selector switch in cover.

Part 3 Execution

3.1 INSTALLATION

.1 Install photoelectric controls in accordance with manufacturer's instructions.

.2 Mount contator on wall where indicated.

.3 Connect photo cell to exterior lighting contactor.

.4 Test operation of photocell.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.47-13, Air-Cooled Transformers (Dry Type).

.2 CSA C9-02 (R2016), Dry-Type Transformers.

.3 CAN/CSA C802-94, Maximum Losses for Distribution, Power and Dry-Type Transformers.

.4 CSA C802.2-12, Minimum Efficiency Values for Dry-Type Transformers.

.2 National Electrical Manufacturers Association (NEMA).

.3 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)/ Illuminating Engineering Society (IES)

.1 Standard 90.1-2013 (I-P Edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI Approved; IES Co-sponsored).

1.3 PRODUCT DATA

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

Part 2 Products

2.1 TRANSFORMERS

.1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2 No.47 and CSA-C802.

.2 Design 1.

.1 Type: ANN.

.2 3-phase, input and output voltages as indicated on drawings, 60 Hz.

.3 K rating and special winding configurations for harmonic mitigation as indicated.

.4 Voltage taps:

.1 15 kVA and smaller - 2 x 5% FCBN.

.2 30 kVA and larger – 4 x 2½ % full capacity – high voltage type (2-FCAN & 2-FCBN).

.5 Insulation: Class H, 150°C temperature rise; 115°C rise design.

.6 Efficiency: comply with the lower of CAN/CSA C802 and ASHRAE 90.1

.7 Impedance: Minimum valves as follows:

.1 up to 45 kVA – 1.25%;

.2 75 kVA 2.0%;

.3 112.5 Kva – 3%

.4 150 kVA – 4%.

.8 Basic Impulse Level (BIL): 10 kV.

.9 Hipot: standard.

.10 Average sound level: in accordance with NEMA TRI standard

.11 Impedance at 17 degrees C: standard.

.12 Enclosure: CSA, removable metal front panel, sprinkler proof.

.13 Mounting: floor wall or ceiling suspended as indicated.

.14 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.15 Nameplates to indicate: Rating, impedance, weight, connection diagram, style serial number and manufacture.

.16 Isolation pads installed between the core and coil.

.17 Copper windings.

.18 Separate primary and secondary windings.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Label size: 3.

.3 Nameplate wording example:

.1 T-5 – 30 kVA - 600 to 120/208 V

.2 Source - DP-1/Load - BPA

2.3 HARMONIC MITIGATING TRANSFORMERS

.1 Provide harmonic mitigating transformers as indicated and include the following:

.1 Single output Harmonic Mitigating Isolation Transformers shall be low zero sequence output impedance design and shall reduce the voltage distortion created by the 3rd and other triplen harmonic currents.

.1 3rd, 9th and 15th harmonics and other zero sequence currents shall be treated within the secondary windings through cancelation of the zero sequence fluxes. Simply trapping these currents in the delta primary winding is NOT acceptable.

.2 For 5th, 7th, 17th and 19th harmonics provide the appropriate primary – secondary phase shift in order to cancel these harmonic currents with those or other loads fed from the same primary supply.

.3 The harmonic mitigation shall be by electromagnetic means only. No capacitors or electronics shall be used.

.4 Evidence of relevant application experience must be available upon request.

.2 Zero sequence impedance/reactance at 60 Hz:

.1 <0.95% and <0.3% respectively for sizes up to 150 kVA.

.3 Nameplate rating: K13 rated for non-linear loads, 60 Hz.

.4 Efficiencies:

.1 Meets efficiency levels in accordance with CSA C802.2 as referenced in the Canadian Energy Efficiency Regulations SOR94-651 at an operating range from 35% to 65% of rated linear load.

.2 Efficiencies, no-load losses, load losses and impedance values shall be calculated at temperature reference of 75°C at Unity Power Factor (UPF).

.5 Electrostatic shield for common noise attenuation.

.1 60 dB Common Mode electrical noise attenuation.

.2 10 dB transverse Mode electrical noise attenuation.

.6 Load Compatibility: up to K20 load profile, Crest Factor up to 5.

.7 Secondary Windings: Single.

.8 Primary to secondary phase-shift:

.1 Single output units – upstream cancelation of 5^{th} and 7^{th} harmonics.

.9 Reduction of fundamental current imbalance from secondary to primary of transformer.

.10 Primary to secondary voltage distortion reduction shall be certified and tested with a non-linear Test Bench.

.11 Non-linear performances shall be certified and tested with a non-linear test bench.

.12 Seismic designed and manufactured to comply with applicable standards.

.13 Features:

.1 Electrostatic shielding: double.

.2 Vibration Isolators.

.3 Enclosures: sprinkler proof.

.14 Mounting: Floor, wall or ceiling suspended as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Mount dry type transformers up to 75 kVA suspended or as indicated.

.2 Mount dry type transformers above 75 kVA on concrete housekeeping pad or as indicated. Dry type transformers rated 45 kVA or above shall be mounted on concrete housekeeping pad where indicated to be installed at floor level.

.3 Ensure adequate clearance around transformer for ventilation.

.4 Install transformers in level upright position.

.5 Remove shipping supports only after transformer is installed and just before putting into service.

.6 Provide isolator pads under the transformer enclosure.

.7 Loosen isolation pad bolts until no compression is visible.

.8 Make primary and secondary connections in accordance with wiring diagram.

.9 Energize transformers after installation is complete.

.10 Use flexible conduit to make connections to transformer. Ensure flexible conduit length does not exceed 1000 mm.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Indicate on shop drawings.

.1 Anchoring method.

.2 Dimensioned cable entry and exit locations.

.3 Dimensioned position and size of bus.

.4 Overall length, height and depth.

.5 Dimensioned layout of internal and front panel mounted components.

.3 Include time-current characteristic curves for circuit breakers

.4 Submit for review by the Engineer, shop drawings of all items specified in this Section.

1.2 MAINTENANCE DATA

.1 Provide maintenance data for service entrance protector for incorporation into manual specified in Section 26 05 00 – Common Work Results for Electrical.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 SERVICE ENTRANCE EQUIPMENT

.1 Service Entrance protection rating: 600V, 3 phase, 4 wire, 200 A, short circuit current 22 kA (rms symmetrical).

.2 Moulded case circuit breaker, 100% rated in separate enclosure as indicated on drawing and as specified in Section 26 28 16.02 – Moulded Case Circuit Breakers.

.3 Enclosure EEMAC 12 with provision of terminating incoming service neutral conductor and grounding connection.

.4 Bus bars and main connections; 99.3% copper.

.5 Identify phases with colour coding.

.6 Manufacturer: Eaton, Schneider, Siemens, or approved equivalent.

2.2 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 – Common Work Results for Electrical.

.1 Service entrance main breaker exterior.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.

2.4 ARRANGEMENT

.1 The arrangement shall be as indicated on drawings. Minor modifications to arrangement may be made to suit site conditions.

Part 3 Execution

3.1 INSTALLATION

.1 Provide and connect the main breaker as shown. Make all necessary arrangements with the utility company for service entrance, energization and metering of the services.

.2 Connect system neutral through the meter and terminate in the service protector enclosure.

.3 Run two (2) copper grounding conductors (#2 AWG) TWH green, from ground connection in main breaker enclosure to building AC system ground grid.

.4 Check factory made connections for mechanical security and electrical continuity.

.5 Connect incoming and outgoing cables.

.6 Provide drip hoods, non-ferrous entry plates and other special features as required.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 120/208 V panelboards: bus and breakers rated for 10 kA (symmetrical) interrupting capacity or as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Two keys for each panelboard and key panelboards alike.

.6 Copper bus with neutral of same ampere rating as mains.

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

.9 Trim and door finish: baked grey enamel

.10 Manufacturer: Eaton, Schneider, Siemens, or approved equivalent.

2.2 BREAKERS

.1 Breakers: to Section 26 28 16.02– Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.4 APPROVED MANUFACTURER

.1 Panelboards to be manufactured by Cutler Hammer, Schneider Electric, Siemens or approved equivalent

Part 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards painted with fire retardant paint grey in color. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 – Common Work Results for Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Provide and connect all wiring devices for the complete installation.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 MANUFACTURER

.1 Wiring devices to be of one manufacture throughout project.

.2 Manufacturers shall be Hubbell, Leviton, Smith and Stone, Bryant or Pass & Seymour, commercial specification grade, unless otherwise noted.

2.2 DEVICES

.1 The catalogue numbers shown below are for the particular manufacturer's series and all necessary suffixes shall be added for the requirements as stated. All devices shall be specification grade minimum and wherever possible shall be of the same manufacture.

.2 Devices to be ivory with stainless steel coverplates in all but mechanical areas unless noted otherwise. Use galvanized steel coverplates in mechanical areas and for surface mounted devices.

2.3 SWITCHES

.1 120-277 volt, 20 amp, single and double pole, three and four-way: As Hubbell No. 1221, 1222, 1223 and 1224.

.2 Manually - operated general purpose AC switches shall have the following features:

.1 Terminal holes approved by AWG #10 wire.

.2 Silver alloy contacts.

.3 Urea or melamine molding for parts subject to carbon tracking.

.4 Suitable for back and/or side wiring.

2.4 RECEPTACLES

.1 Duplex 15 ampere, 120 volt, 3 wire, ivory, U-ground, as Hubbell No. 5252, with the following features:

.1 Ivory urea molded housing.

.2 Suitable for #10 AWG for back and side wiring.

.3 Eight back wired entrances, four side wiring screws.

.4 Break-off links for use as split receptacles.

.5 Triple wipe contacts and rivetted grounding contacts.

.2 Duplex 15 ampere, 120 volt, 3 wire, ivory, U-ground ground fault receptacle, as Hubbell No. GF-5261.

2.5 VEHICLE RECEPTACLES

.1 Duplex 15 ampere, 125 volt, 3 wire, time and temperature controlled receptacle, as ILPC M210, with the following features:

.1 Outdoor rated with weatherproof cover.

.2 Load limit: 1800W.

.3 Initial power delay: 2 hours.

.4 Green and Red indicating LED lights.

.5 Programmable profile. Preprogrammed as follows:

.1 Temperature above -5°C: 0% of time ON.

.2 Temperature between -5°C and -9°C: 10% of time ON.

.3 Temperature between -10°C and -19°C: 32.5% of time ON.

.4 Temperature between -20°C and -24°C: 77.5% of time ON.

.5 Temperature equal to or below -25°C: 100% of time ON.

.6 Acceptable Manufacturer: ILPC M210.

2.6 COVERPLATES

.1 Provide coverplates for all wiring devices.

.2 Use sheet steel utility box cover for wiring devices installed in surface mounted boxes.

.3 Use nylon coverplates on all wiring devices mounted in flush-mounted outlet boxes unless otherwise specified.

.4 Weatherproof double lift spring - loaded cast aluminum coverplates, complete with gaskets for single receptacles or switches.

.5 Use gasketted DS cast covers on FS and FD type boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Install single throw switches with handle in the "UP" position when switch closed.

.2 Install switches vertically in gang type outlet box when more than one switch is required in one location.

.3 Mount switches on the latch side of the doorway as close as possible to door frame unless otherwise indicated on drawings.

.4 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.

.5 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.6 Install suitable common coverplates where wiring devices are grouped. Do not distort plates by tightening screws excessively.

.7 Do not use coverplates meant for flush outlet boxes on surface mounted boxes.

.8 Wherever possible, mount equipment in a straight line at a uniform mounting height, coordinated with other equipment and materials.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 24 03 - Service Entrance Protector

.3 Section 26 24 16.01 - Panelboards Breaker Type

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-13, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 SUBMITTALS

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

.2 Include time-current characteristic curves for breakers with ampacity of 200A and over.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers: to CSA C22.2 No. 5

.2 ULS/ULI/CAS listed, certified, labelled and supplied by a single manufacturer.

.3 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.4 Common-trip breakers: with single handle for multi-pole applications.

.5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.6 Circuit breakers to have minimum symmetrical rms interrupting capacity rating at 600 V – 14,000 amperes; at 250 volt and below – 10,000 amperes.

.7 Manufacturer: Eaton, Schneider, Siemens or approved equivalent.

2.2 THERMAL MAGNETIC BREAKERS FOR GENERAL APPLICATION

.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.

2.3 MAGNETIC BREAKERS FOR INDIVIDUAL BRANCH MOTOR PROTECTION

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4 GROUND FAULT INTERRUPTION (GFI) CIRCUIT BREAKER

.1 Ground Fault Interruption (GFI) breakers, 2 – pole, with over-load short circuit protection combined with Class A ground fault protection.

.1 Class A denotes a GFCI that will trip when a fault current to ground 6 milliamp or more.

.2 10.000 Amperes Interrupting Rating (AIR).

.2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.

.1 Breakers applied following manufacturer's guidelines and accepted best practice.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers in separate enclosures and in paneboards as indicated and specified.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 Provide disconnect switches for 120/240 volt distribution as indicated on the drawings, as manufactured by Cutler Hammer, Schneider Electric or Siemens.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Ratings: Voltage and Ampere ratings as shown on the drawings or to suit load requirements. For motors, use disconnect switches with HP ratings at least equal to motor HP.

.2 Enclosures: CSA code gauge galvanized steel, hinged doors, external operating handles. Disconnect switches in dry locations shall be EEMAC-1, EEMAC-3 where exposed to weather and Class 1 Div 11 Group D where installed in classified areas. Provide ON-OFF switch position indication on switch enclosure cover.

.3 Finish: One primer coat and one finished coat on all metal surfaces, colours as per Section 26 05 00 – Common Work Results for Electrical.

.4 Switch mechanisms: Quick make and quick break action with self wiping contacts, solderless pressure lug connectors. For switches 100 amperes and over, provide non-tracking arc shrouds. All switch poles to operate together from a common operating bar. Provide for padlocking disconnect switches in "Off' position. Doors to be interlocked and complete with defeat mechanism, to prevent opening when handle in ON position.

Part 3 Execution

3.1 DISCONNECT SWITCHES

.1 Mounting: Provide supports independent of conduits. Wall mount where possible, otherwise provide Unistrut frame support. Where switches are grouped mount in uniform arrangement.

.2 Wiring: Connect line and load cable to all switches.

.3 Identification: Provide lamacoid plate in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.14-13, Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1-2000 (R2015), Industrial Control and Systems: General Requirements.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Include schematic, wiring, interconnection diagrams.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 REMOTE NOTIFICATION SYSTEM

.1 Automatic dialer type, as per RACO Verbatim complete with optional I/O modules and sealed NEMA-4X type enclosure.

.2 The automatic dialer shall be a self-contained, solid state device. The dialer shall continuously monitor the presence of main power and the status of four independent alarm input channels, which may be programmed for N.O. or N.C. dry-contact (or logic levels) inputs or for 4−20 mA analog inputs. Provide optional I/O modules as required.

.3 On AC power failure (for dialer with backup battery option) and / or on violation of alarm criteria for any of the four alarm inputs, the dialer shall go into alarm status and begin alarm dialing and alarm notification. Dialing shall continue until the alarm(s) is (are) acknowledged.

.4 Unless alarm notification is by pager, notification shall be by playback of high resolution digitally recorded alarm voice messages. Each alarm shall cause the playback of its specific custom message. Analog alarm messages shall include the percent-of-full-scale of the analog inputs.

.5 Alarm acknowledgement shall be accomplished by pressing the 9-button on the telephone touch pad or by using the switch on the dialer front panel. Call-back alarm acknowledgement capability shall be available in the event that alarm notification is by numeric pager.

.6 The dialer shall re-alarm and resume alarm dialing after a programmable period of time has elapsed after an alarm(s) has been acknowledged but the fault(s) causing the alarm(s) not remedied.

.7 The dialer shall respond to inquiry calls from any telephone and shall provide a status report of alarm input point status (OPEN, CLOSED, or analog PERCENT) and main power status. The report shall include alarm status for each point (normal, alarm, and alarm acknowledged but fault not remedied). A warning message shall be provided if no phone numbers have been programmed for alarm notification or if the switch on the dialer front panel is set to DISARMED rather than READY.

.8 Phone Link:

.1 The dialer shall be FCC approved. It shall operate on a standard dial-up rotary pulse or touch-tone telephone line and shall be capable of calling from one to eight phone numbers, each up to 60 digits in length. Dedicated or lease phone lines shall not be required.

.9 Power, Operational Backup Battery, and User Program Storage:

.1 Main power for the dialer shall be either 10−14 VDC or 105−135 VAC. The latter requires the GAC option.

.2 Backup power to allow dialer operation should main power be lost shall be by an internal 6 V, 4 AH gel cell rechargeable battery and precision voltage controlled charger, option GBB. A trickle charger shall not be supplied. Battery backup shall be 20 hours.

.3 User program storage shall be by an internal lithium battery rated for 10 years from date of shipment. Dialer operating system and default voice messages shall be stored in non-volatile memory.

2.2 AC CONTROL RELAYS

.1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

.2 Convertible contact type: contacts field convertible from NO to NC, types as indicated as follows: electrically held; permanent magnet latched; double-voltage type with sliding barrier to permit access to contacts only or coil only; with solid state timer. Coil rating: voltage and burden (VA) as indicated. Contact rating: voltage and current as indicated.

.3 Sealed contact type: electrically held permanent magnet latched with poles and front mounted contact block to provide additional poles. Coil rating: voltage and burden (VA) as indicated. Contact rating: voltage and current as indicated.

.4 Universal pole type: electrically held type with poles, convertible from NO to NC by changing wiring connections. Coil rating: voltage and burden (VA) as indicated. Contact rating: voltage and current as indicated.

.5 Fixed contact plug-in type: general purpose or low coil current heavy duty with multiple poles. Coil rating: voltage and burden (VA) as indicated. Contact rating: voltage and current as indicated.

.6 LED light to indicate relay is active.

2.3 RELAY ACCESSORIES

.1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.4 PUSHBUTTONS

.1 30 mm, LED illuminated, heavy duty oil tight. Operator recessed with 1-NO and 1-NC 120 V contacts rated at 10 A, AC, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position labelled "stop". Emergency stop with red mushroom head.

2.5 SELECTOR SWITCHES

.1 30 mm, maintained 2 or 3 position labelled as indicated; heavy duty oil tight; operator’s standard knob, contact arrangement as indicated, rated 10 A, 120 V AC.

2.6 INDICATING LIGHTS

.1 30 mm, heavy duty oil tight, transformer LED type, push-to-test, lens colours: as indicated, supply voltage 120V, lamp voltage 120V, labels as indicated.

2.7 CONTROL AND RELAY PANELS

.1 NEMA 4/12 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.8 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary: 60 Hz ac and secondary voltages as indicated.

.3 Rating: as indicated or required for control circuit burden.

.4 Secondary fuse: select for short circuit protection.

.5 Close voltage regulation as required by magnet coils and solenoid valves.

2.9 TERMINAL BLOCKS

.1 For installation in terminal cabinets

.2 Terminals blocks to be heavy duty industrial spring clamp rated 300 volts, mechanical pressure type with self-locking provision

2.10 MOUNTING

.1 Mount all components on 35 x 15 mm DIN-RAILS; Rails are to be mounted on back plate with 50 mm off set brackets.

Part 3 Execution

3.1 INSTALLATION

.1 Install pushbutton stations, control and relay panels, control devices and interconnect.

.2 Install Autodialer and interconnect with controls equipment.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 91 13 – General Commissioning Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

.1 The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

.1 ANSI/IEEE C62.41-2002, IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits and C62.45-2002 - IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

.2 ANSI/IEEE C62.1-1989 IEEE Standard for Surge Arresters for Alternating-Current Power Circuits and C62.11-2012 - IEEE Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV).

.3 National Electrical Manufacturer's Association (NEMA LS-1 -1992 (R2000) Guidelines), Low Voltage Surge Protection Devices.

.4 Underwriters Laboratories UL 1449, Third Edition, 2014 Surge Protective Devices and UL 1283, UL 1283-2015, Electromagnetic Interference Filters.

.5 IEEE Standard 1100-2005 - IEEE Recommended Practice for Powering and Grounding Electronic Equipment.

.2 The unit shall be UL 1449 Third Edition Listed and CUL approved as a Surge Protective Device and UL 1283 listed as an Electromagnetic Interference Filter.

1.3 SUBMISSIONS

.1 Submit Shop Drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit complete drawings and data including dimensions, configuration and all certified performance and test data.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.1 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 GENERAL

.1 Provide TVSS unit beside main distribution panel as indicated on drawings.

.2 Rating of TVSS unit to be suitable for protection of distribution equipment connected.

.3 Nominal line voltages:

.1 120/208 V, 3 phase, 4 wire, grounded wye.

.4 Monitoring Display:

.1 Surge counter
.2 All phase voltage display
.3 G voltage and current display
.4 Audible alarm
.5 Dry contacts
.6 All phase LED's monitoring

.5 Protection Modes:

.1 WYE configures systems providing line-to-ground and line-to-line protection.

.6 Maximum continuous operating voltage (MCOV) shall be greater than 115% of nominal voltage.

.7 Operating frequency range shall be 47 to 63 Hertz.

.8 Units shall include an engineered solid-state high performance suppression system utilizing arrays of non-linear voltage dependent metal oxide varistors with similar operating characteristics. The suppression system components shall optimally share surge currents in a seamless, low-stress manner assuring maximum performance and proven reliability. The suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads.

.9 The unit shall include a high frequency extended range power filter and shall be UL 1283 listed as an Electromagnetic Interference Filter. The filter shall reduce fast rise-time, high frequency, error-producing transients and electrical line noise to harmless levels. The filter shall provide minimum noise attenuation as specified herein.

.10 Internal Connections:

All full magnitude transient current shall be conducted utilizing low-impedance copper bus bar. No plug-in component modules or quick-disconnect terminals shall be used in surge current-carrying paths.

.11 Field Connections:

.1 The unit shall include mechanical or compression lugs for each phase, neutral and ground.

.12 Units supplied in a separate NEMA 4 metal enclosure or mounted within distribution equipment enclosure. Flush mounted.

.13 Manufacturer: ABB, Eaton, Schneider, Siemens or approved equivalent.

2.2 TVSS UNITS

.1 TYPE 1

.1 Rated Single Pulse Surge Current Capacity:

.1 The rated single pulse surge current capacity, in Amps, for each mode of protection of the unit shall be no less than:

L-G	80,000 A
L-L	80,000 A

.2 **Wave forms (µs) 10/350**

.2 Testing:

In compliance with NEMA-LS-1, the unit shall have single pulse surge current tested in all modes at rated surge currents by an industry-recognized independent test laboratory. The test shall include a UL 1449 Third Edition surge to benchmark the unit's suppression voltage, followed by a single pulse surge of maximum rated surge current. To complete the test another UL 1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two UL 1449 surges does not vary by more than 10%.

.3 Minimum Repetitive Surge Current Capacity:

Per ANSI/IEEE C62.41- Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits and ANSI/IEEE C62.45- EEE Guide on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

.4 Clamping voltages for 208 V, 3-phase, 4 wire system:

	UL 1449 3rd Edition SVR
L - G	700
L - L	1000

5 High Frequency Extended Range Power Filter**:** Filter system EMI-RFI noise rejection, or attenuation values shall be in compliance with test and evaluation procedures outlined in NEMA LS-1.

.6 Overcurrent Protection**:**

.1 Each suppression element shall be individually fused to ensure that the failure of a single component or the operation of a single fuse element remains isolated and does not render the entire mode, or product, deficient by more than 10%.

.2 All fuses and overcurrent/fault current protection devices shall consist of self arch-quenching, sand-encapsulated UL248-1 Recognized fuse arrays. Each fuse shall be individually sealed in a manner that eliminates cross arching.

.7 Transient Conduction Path**:**

All full magnitude transient current shall be conducted on low-impedance solid copper bussing. If printed circuit boards are utilized in surge current paths, no single trace shall be allowed to conduct more than the proportional current share of the connected TVSS component.

.2 TYPE 2

.1 Rated Single Pulse Surge Current Capacity:

.1 The rated single pulse surge current capacity, in Amps, for each mode of protection of the unit shall be no less than:

L-G	80,000 A
L-L	80,000 A

.2 **Wave forms (µs) 8/20**

.2 Testing:

In compliance with NEMA-LS-1, the unit shall have single pulse surge current tested in all modes at rated surge currents by an industry-recognized independent test laboratory. The test shall include a UL 1449 Third Edition surge to benchmark the unit's suppression voltage, followed by a single pulse surge of maximum rated surge current. To complete the test another UL 1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two UL 1449 surges does not vary by more than 10%.

.3 Minimum Repetitive Surge Current Capacity:

Per ANSI/IEEE C62.41- Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits and ANSI/IEEE C62.45- EEE Guide on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

.4 Clamping voltages for 208V, 3-phase, 4-wire system:

	UL 1449 3rd Edition SVR
L – G	700
L – L	1000

.5 High Frequency Extended Range Power Filter**:** Filter system EMI-RFI noise rejection, or attenuation values shall be in compliance with test and evaluation procedures outlined in NEMA LS-1.

.6 Overcurrent Protection**:**

.1 Each suppression element shall be individually fused to ensure that the failure of a single component or the operation of a single fuse element remains isolated and does not render the entire mode, or product, deficient by more than 10%.

.2 All fuses and overcurrent/fault current protection devices shall consist of self arch-quenching, sand-encapsulated UL248-1 Recognized fuse arrays. Each fuse shall be individually sealed in a manner that eliminates cross arching.

.7 Transient Conduction Path**:**

All full magnitude transient current shall be conducted on low-impedance solid copper bussing. If printed circuit boards are utilized in surge current paths, no single trace shall be allowed to conduct more than the proportional current share of the connected TVSS component.

Part 3 Execution

3.1 MOUNTED

.1 Mount on wall in electrical room as close as practical to the distribution panel.

3.2 MANUFACTURER'S INSTRUCTIONS

1 Carry out installation in accordance with manufacturer's instructions.

3.3 CONNECTIONS

.1 Connect from breaker in distribution panel. Keep conductor lengths as short and straight as possible.

3.4 GROUND CONNECTIONS

.1 Make ground connection to main building ground using short straight length of stranded bare copper conductor minimum size No. 2 AWG.

3.5 DOCUMENTATION

.1 The manufacturer shall provide data showing UL 1449 Third Edition product listing and certified documentation of applicable Location Category Testing in full compliance with NEMA LS-1 (R2000).

3.6 FIELD QUALITY CONTROL

.1 Refer to Section 01 91 13 General Commissioning Requirements and Section 26 05 00 Common Work Results for Electrical.

.2 Pay all costs for manufacturers technical representative to perform installation field tests.

- .1 Perform unit self diagnostic test.
- .2 Start-up testing includes:
  - .1 Voltage measurement at installation.
  - .2 Impulse injection to confirm system suppression tolerances (off-line).
  - .3 Visually inspect grounding.
- .3 Visual inspection of all wiring and ground connections.
- .4 Confirm indication lamp operation.
- .5 Record surge counter number.

.3 Provide written report of all test results. Perform all tests in the presence of the Engineer and include copies of test results in the Operation and Maintenance Manuals.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 This specification covers Variable Frequency Drive (VFD) systems designed for speed control of three-phase, 600V standard NEMA Design B induction motors or Inverter Duty rated motors, as per NEMA MG1, parts 30 and 31.

.2 Work includes the supply, installation and setup of microprocessor controlled, fully digital, programmable variable fre

1.2 REFERENCES

.1 Underwriter's Laboratories of Canada (ULC).

.1 UL 508C-2008, Standard for Power Conversion Equipment.

.2 International Organization for Standardization (ISO).

.1 ISO 9001:2008, Quality Management Systems – Requirements.

.3 National Electrical Code (NEC-2014).

.4 Institute of Electrical and Electronics Engineers, Inc. (IEEE).

.1 IEEE 519-2014, IEEE Recommended Practice and Requirements for Harmonic Control in electric Power Systems.

.5 International Electrotechnical Commision (IEC).

.1 EN/IEC 61800-3, Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods, 2017.

.6 National Electrical Manufacturers Association (NEMA).

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS7-2014, Adjustable Speed Drives.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. For each type of VFD include product characteristics, performance criteria, limitations, mounting arrangements, required clearances and service space around equipment, listings, enclosure types and conduit entry locations and sizes.

.2 Provide schematic power and control wiring diagrams and complete list of all standard and optional features.

.2 Quality assurance submittals: submit the following:

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

.2 VFDs and options shall be ULC listed as a complete assembly and shall comply with the latest requirements of the standards of ANSI, IEEE, NEMA and the National Electric Code.

.3 The complete VFD assembly, including all standard and optional features shall be functionally tested at the factory for proper operation.

Part 2 Products

2.1 GENERAL

.1 The VFD package as specified herein shall be enclosed in a UL Type enclosure (Type 1 or Type 12 as indicated), completely assembled and tested by the manufacturer in an ISO9001 facility. With the exception of VFD output filters, all equipment and accessories described herein for the operation and adjustment of the VFD shall be installed within the VFD enclosure.

.2 Complete VFD assembly tested to UL 508C, with the appropriate UL/ULC label applied.

.3 The VFD shall be ULC listed for a short circuit current rating (SCCR) of 50 kA and labelled with this rating.

.4 VFD and all necessary controls specified herein to be supplied by a single manufacturer. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten (10) years.

.5 All VFDs supplied under this section must be from the same manufacturer.

.6 As per ABB ACH550 series with E-Bypass, or approved equivalent from Yaskawa, Cuttler-Hammer.

2.2 FREQUENCY CONTROLLER

.1 The variable frequency drive (VFD) shall be a pulse width modulated (PWM) AC to AC converter utilizing the latest isolated gate bipolar transistor (IGBT) technology. The VFD power electronic system consists of:

.1 Input Section:

.1 VFD input power stage shall convert three-phase AC line power into a fixed DC voltage via a solid state full wave diode rectifier, with MOV (Metal Oxide Varistor) surge protection.

.2 A 5% DC bus impedance to minimize reflected current.

.2 Intermediate Section:

.1 DC bus as a supply to the VFD output Section shall maintain a fixed voltage with filtering and short circuit protection.

.2 DC bus shall be interfaced with the VFD diagnostic logic circuit, for continuous monitoring and protection of the power components.

.3 Output Section

.1 Insulated Gate Bipolar Transistors (IGBTs) shall convert DC bus voltage to variable frequency and voltage.

.2 The VFD shall employ PWM sine coded output technology to power the motor.

.2 Rating:

.1 Input rating: 600 Volts +/- 10%, 3-Phase, 57 to 63 Hz.

.2 Output rating: 0-600 Volts, 3-Phase, 3 to 60 Hz.

.3 Overload Capacity: 110% of rated current for 60 seconds and peak overload of 130% of rated current for 2 seconds.

.4 Minimum efficiency at full load: 95%.

.5 Displacement power factor (all speed): 0.96.

.6 The VFD must be able to produce full torque at low speed to operate submersible pump.

.7 Coordinate final rating with pump size.

.8 4-20mA Speed Control.

.3 Environmental Ratings:

.1 Enclosure: CSA Type 1, wall mounted as shown on drawings.

.2 Ambient Temperature: 0 – 40 degrees Celsius.

.3 Humidity: 5-90% non-condensing.

.4 Galvanic isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete digital I/O shall include additional isolation modules.

.5 VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.

.6 Protective Features:

.1 Fused input for both VFD and bypass modes.

.2 UL508 (I^2t) electronic motor overload protection.

.3 Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Alpha-numeric codes are not acceptable.

.4 Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.

.5 VFD shall include a "signal loss detection" algorithm with adjustable time delay to sense the loss of an analog input signal. It shall also include a programmable time delay to eliminate nuisance signal loss indications. The functions after detection shall be programmable.

.6 VFD shall catch a rotating motor operating forward or reverse up to full speed without VFD fault or component damage.

.7 Selectable over-voltage control shall be provided to protect the drive from power regenerated by the motor while maintaining control of the driven load.

.8 VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.

.9 The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.

.7 Line Conditioning and Filtering:

.1 Include internal mounted components to mitigate harmonic distortion, provide protection from input transients and reduce EMI/RFI emissions as required for each application. At a minimum, each VFD shall include the following:

.1 AC Line:

.1 The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients.

.2 The 5% impedance may be from DC link choke or 5% AC line reactors.

.3 For VFDs above 10HP provide both DC chokes and AC line reactors with a combined impedance of 8%.

.2 Motor Filter:

.1 Provide a RLC type filter at the drive output to protect the motor from high voltage transients and reduce high frequencies at the VFD output. Complete with UL Type 1 enclosure for mounting beside VFD.

.3 EMI / RFI filters:

.1 All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard IEC/EN 61800-3 for the First Environment restricted level with up to 100 feet of motor cable. Certified test reports shall be provided with the submittals confirming compliance to IEC/EN 61800-3, First Environment.

2.3 CONTROL PANEL

.1 The frequency controller and its protections are mounted directly in the control panel enclosure, complete with an interlocked, padlockable disconnect switch on the panel's front door.

.2 On the panel front door, a microprocessor based operator interface allows the user to adjust/verify the VFD's operating parameters, running speed and output, as well as visualizing VFD status and alarm conditions.

.3 User Interface:

.1 Hand, Off and Auto keys shall be provided to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation.

.2 There shall be an "Info" key on the keypad. The Info key shall include "on-line" context sensitive assistance for programming and troubleshooting.

.3 The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.

.4 Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes.

.5 All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.

.6 Display shall be programmable to communicate in multiple languages including English, French and Spanish.

.7 A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

.8 Last (10) VFD faults are recorded in the controller memory with the following information: date, time, fault description VFD output (V, amps and frequency) at time of fault.

.9 Five (5) simultaneous meter displays shall be available. They shall include at a minimum, frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, among others.

.10 A run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of initiating an output "run request" signal to indicate to the external equipment that the VFD has received a request to run.

.11 VFD shall be programmable to display feedback signals in appropriate units, imperial and metric.

.12 VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.

.13 Standard Control and Monitoring Inputs and Outputs:

.1 Four (4) dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

.2 Two (2) terminals shall be programmable to act as either as digital outputs or additional digital inputs.

.3 Two (2) programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status.

.1 Each relay shall have an adjustable on delay / off delay time.

.4 Two (2) programmable analog inputs shall be provided that can be either direct-or-reverse acting.

.1 Each shall be independently selectable to be used with either an analog voltage or current signal.

.2 The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA.

.3 A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.

.4 The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,

.5 One (1) programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.

.6 It shall be possible through serial bus communications to read the status of all analog and digital inputs of the VFD.

.7 It shall be possible to command all digital and analog output through the serial communication bus.

.14 Optional Control and Monitoring Inputs and Outputs:

.1 It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.

.2 These modules shall use rigid connectors to plug into the VFD's control card.

.3 The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module.

.4 Modules may include such items as:

.1 Additional digital outputs, including relay outputs.

.2 Additional digital inputs.

.3 Additional analog outputs.

.4 Additional analog inputs, including Ni or Pt temperature sensor inputs.

.5 It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.

.4 Standard programmable firefighter's override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display FIREMODE whenever in firefighter's override mode. Firemode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.

.5 A real-time clock shall be an integral part of the VFD.

.1 It shall be possible to use this to display the current date and time on the VFD's display.

.2 The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log.

.6 Adjustments:

.1 The VFD shall have a manually adjustable carrier frequency that can be adjusted in 0.5 kHz increments to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.

.2 Four (4) preset speeds per setup shall be provided for a total of sixteen (16).

.3 Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.

.4 Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer, which will cause the VFD to trip off after a programmed time period.

.5 If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload.

.6 The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

.7 An automatic "start delay" may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.

.8 Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

2.4 BYPASS WITH MAGNETIC CONTACTORS

.1 Bypasses shall be furnished and mounted by the drive manufacturer. All VFD with bypass configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

.2 Description:

.1 A complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses. UL Listed motor overload protection shall be provided in both drive and bypass modes.

.2 The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the "Off" position before either enclosure may be accessed.

.3 Drive Isolation Fuses - To ensure maximum availability of bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure.

.4 Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication.

.5 Motors 20 HP or greater must be protected with thermistor type motor protection relays, in both VFD or Bypass mode.

.6 The bypass system shall be designed for stand-alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement.

.7 Serial communications – the bypass shall be capable of being monitored and / or controlled via the serial communications.

.8 The bypass shall include the ability to select the operating mode of the system (VFD/Bypass) from either the bypass keypad or digital input.

2.5 INCLUDED OPTIONS

.1 With the exception of output filters, all optional features shall be built and mounted by VFD manufacturer. These optional features shall be ULC listed by the VFD manufacturer as a complete assembly and carry a ULC label.

.2 All panels shall be marked for their short circuit current rating in compliance with ULC.

2.6 SERVICE CONDITIONS

.1 Ambient temperature, continuous, full speed, full load operation:

.1 -10 to 40°C.

.2 0 to 95% relative humidity, non-condensing.

.2 Plenum rated (UL-1995 standard or NEMA12) as indicated.

2.7 VFD SCHEDULE

SYSTEM	MOTOR (HP)	BYPASS	PLENUM RATED	REMARKS
WP-01	10	yes	No	
WP-02	10	yes	No	
WP-03	10	yes	No	

2.8 ACCEPTED MANUFACTURERS

.1 Variable Frequency Drives (VFDs):

.1 ASEA Brown Boveri (ABB)

.2 Eaton Cutler-Hammer

.3 Yaskawa

.2 Filters and Reactors:

.1 MTE

.2 TCI

.3 ASEA Brown Boveri (ABB)

.3 Overload relays, disconnects:

.1 ASEA Brown Boveri (ABB)

.2 Eaton Cutler-Hammer

.3 Siemens

.4 Square D

.5 Klockner-Moeller

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations and specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 START-UP SERVICE

.1 Factory start-up shall be provided for each drive by a factory authorized and certified service technician. A start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer. Verification shall include: proper operation and installation of the VFD, its optional features, interface wiring and serial communications to the building automation system.

.2 Harmonic filtering: Given the information provided on the electric power single line diagram and distribution transformer data, the VFD manufacturer shall carry out an analysis of the system. The analysis must review the potential for the proposed equipment to meet IEEE-519 recommendations (maximum 3% Total Harmonic Distortion). If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE-519 recommendations, then the cost of such equipment shall be carried by the VFD supplier. Provide a report indicating the results of the analysis and any additional filter requirements to the Engineer for review.

3.3 WARRANTY

.1 The complete VFD shall be warranted by the manufacturer for a period of 36 months from the date of start-up. The warranty shall include parts, labour, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer and not a third party. A written warranty statement shall be provided with the submittals.

3.4 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.5 TRAINING

.1 Provide the services of certified technician, from the manufacturer or its authorized distributor, to provide instruction on operation and maintenance of the VFD assembly, all included accessories and the user control interface. Allow for a total of four (4) hours of training.

.2 Provide training materials (documentation, CD, video, etc.) for O&M use.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Division 23 - Mechanical

.2 Section 26 05 00 – Common Work Results for Electrical.

.3 Section 26 05 02 – Testing, Verification, Commissioning and Training Electrical Systems

.4 Section 26 28 23 - Disconnect Switches Fused and Non-Fused

.5 Division 27 - Communications

1.2 PROTECTION, CONTROL AND CONNECTION REQUIREMENTS

.1 In general, there are categories of starting equipment for single phase motors.

.1 Integral Mounted Starters: Some items of mechanical equipment such as boilers, waste water pump control panels, and grinder control panels, have the starter(s) mounted as part of the equipment. For this equipment, supply line side feeder protection and wire to the terminals of the equipment.

.2 Separately Mounted Starters: For motors without integral mounted starters, supply separately mounted starters as indicated on the Drawings and wire the equipment.

.2 Provide manual starters for all single phase motors unless otherwise indicated on the motor schedule.

.3 Provide interlocking between starters where required.

.4 Provide all starter accessories such as pilot lights, Hand-Off-Auto, Start-Stop, etc. whether integrally or remote mounted. These shall be heavy duty oil tight, unless otherwise specified.

.5 Provide isolating disconnect devices at motors.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results for Electrical.

.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 of starter

.6 Interconnection diagrams.

1.4 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 26 05 00 – Common Work Results for Electrical.

.2 Include operation and maintenance data for each type and style of starter.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 MATERIALS

.1 Starters: Nema rated.

2.2 ENCLOSURE

.1 All individually mounted motor starters shall be enclosed in a NEMA 4/12 sheet steel enclosure unless in wet areas where they shall be watertight NEMA 3R.

2.3 MANUAL MOTOR STARTERS

.1 Manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break

.2 Overload heaters, manual reset, trip indicating handle

.3 Rated volts and poles to suit application.

.2 Accessories:

.1 Toggle switch: standard labelled as indicated.

.2 Indicating lights: standard heavy duty type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.4 FULL VOLTAGE NON REVERSING (FVNR) MAGNETIC STARTERS

.1 Provide motor starters of the electro-mechanical type with the coil controlled by an application specific microprocessor.

.2 Provide one (1) current sensor accurate to 2% for each phase to provide motor running overload protection that yields a time current curve closely paralleling that of the respective motor heating damage boundary. Running overload protection shall be DIP switch selectable for the specific motor full load amperes.

.3 Provide DIP switch selectable overload trip class of 10, 20 and 30.

.4 Provide phase loss protection and phase unbalance protection. If the phase unbalance on any of two phases is greater than 30% of the DIP switch selected trip rating, a phase loss/unbalance trip occurs.

.5 Provide each motor starter with a snap-in window which allows clear visibility of overload DIP switch settings and prevents unwanted tampering of DIP switch settings once installed.

.6 Motor starters shall have replaceable fixed and movable contacts.

.7 Accessories

.1 Motor starter shall be designed to accommodate two auxiliary contact blocks, each capable of a combination of up to four normally closed or four normally open auxiliary contacts. Contacts to be color-coded; black designating NC and silver designating NO. Contacts to be rated 10 amperes continuous, 7200 VA make, 720 VA break for 120 through 600 volts AC, and 69 VA make and break for 125 through 300 volts DC. Provide a minimum of one (1) spare NO contact and one spare NC contact in addition to any auxiliary contacts required.

.8 In the starter cover provide manual devices in cover push button ON/OFF; or 3 position selector switch and status pilot lights – green OFF; Red – on as shown on the motor starter.

.9 Microprocessor-based motor control shall be Cutler-Hammer IT Series or approved equal.

Part 3 Execution

3.1 REFERENCE

.1 Refer to Motor Control Equipment Schedule .

.2 Refer to control and instrument details on the drawing.

3.2 STARTER VERIFICATION

.1 Field check motor starters and variable frequency drives, supplied prior to commissioning equipment. As a minimum, verify the following:

.1 Check of control circuits

.2 Verify that overload relay installed is correctly sized for motor used

.3 Record overload relay size and motor nameplate amperage

.4 Ensure all connections are tight.

.2 Measure and record motor amps, under load conditions and compare with full load amps and motor service factor. Report any excessive readings and unbalance. Measure voltage as close to motor terminals as possible while motor is running

.3 Set all motor circuit protectors to the minimum level which will consistently allow the motor to start under normal starting conditions.

3.3 OVERLOAD RELAYS

.1 For starters provided, select overload relays in accordance with relay and motor manufacturers' recommendations, considering motor service factors, ambient temperature, temperature differences between motor and starter locations. Monitor motor operation during startup to ensure motor operation is satisfactory and relays provide proper protection. For side inlet fans and other long acceleration time loads, provide special overload relays to suite the start-up condition. Provide manufacturers' curves and data sheets where necessary to provide supporting data for motor protection.

3.4 INSTALLATION

.1 Install starters, variable frequency drives, connect power and control as indicated.

.2 Ensure correct overload devices elements installed.

.3 Provide a complete system of wiring to motors and controls as specified herein and as shown on the drawings.

.4 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under all contracts related to this project. Examine the drawings and shop drawings of all Divisions for the extent of electrically operated equipment supplied under other contracts.

.5 All control wiring diagrams shown on the drawings illustrate typical control circuits applicable to the equipment. Control circuits may vary with different manufacturers of equipment. Verify all control circuits with the suppliers of the equipment and make any corrections that may be required.

.6 Unless specifically noted otherwise, supply all pushbuttons, relays, starters, etc., necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.

.7 Do not operate motors and controls until approval is obtained from the trade providing equipment.

.8 Examine drawings and shop drawings of other Divisions to obtain exact location of motors and equipment shown on drawings. Where necessary, obtain conduit locations from other trades' drawings and shop drawings.

.9 Assist in placing in operation all mechanical equipment having electrical connections.

.10 Provide three phase starters with fused 120 volt control transformers and overload relays.

.11 Provide all power wiring for all motors and control wiring as indicated on the drawings.

.12 In general, wiring for freezestats, firestats, E.P. switches, P.E. switches, dampers, temperature controllers, flow switches, solenoid valves, etc., for heating and ventilating equipment. Provide terminals in starters and MCCs for control wiring and extend starter control circuits to all field devices.

.13 Provide isolation disconnect switches adjacent to all motors.

.1 3-phase motors:

.1 Provide unfused heavy duty industrial switches as specified in Section 2628 23 - Disconnect Switches Fused and Non-Fused.

.2 NEMA 3R indoors, NEMA 4X outdoor.

.3 Use explosion proof switches in the hazardous well area.

.4 Switches to be horsepower rated.

.2 120 volt single phase motors: provide manual starter without overload relay.

.3 208 volt single phase motors: provide manual starter without overload relay.

3.5 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 - Testing, Verification, Commissioning and Training Electrical Systems and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, variable frequency drives, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Section 23 11 13 – Facility Fuel Oil Piping

.2 Section 23 21 13 - Pipe and Pipe Fittings

.3 Section 23 31 13.01 Metal Ducts – Low Pressure to 500 Pa

.4 Section 23 33 00 - Air Duct Accessories

.5 Section 26 36 23 - Automatic Transfer Switch

1.2 DESCRIPTION OF SYSTEM

.1 Generation system consists of:

- .1 Engine
- .2 Engine/alternator common base plate
- .3 Unit mounted standing generator control panel
- .4 Engine-driven fan and unit-mounted radiator
- .5 Battery charger and battery
- .6 Fuel day tank system and accessories
- .7 Cooling air ventilation system accessories
- .8 Engine exhaust silencer, flex actions and accessories
- .9 Alternator output circuit breaker in control panel
- .10 Vibration isolators and seismic restraints
- .11 Factory testing
- .12 Site delivery, installation, and connections
- .13 Site commissioning and demonstration
- .14 Generator.

.2 Generator set and automatic transfer switch system to be designed for automatic emergency standby power.

.3 Generator set to include automatic shutdown and alarm indication for:

- .1 Low oil pressure
- .2 High coolant temperature
- .3 Overspeed
- .4 Over-crank
- .5 Emergency stop.

.4 Generator set to include warning systems and indication for:

- .1 Low oil pressure
- .2 Low coolant temperature

.3 Low battery voltage

.4 Generator output breaker open

.5 Selector switch "not in automatic" position

.6 Coolant temperature rising.

1.3 STANDARDS

.1 Canadian electrical code and territorial and local amendments.

.2 National building code.

.3 Local building code.

.4 NEMA Motor and Generator Standards.

.5 CSA Standard C282 – Emergency Electrical Power Supply in Building.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Production shall not be started until all applicable shop drawings have been submitted to the Engineer for review.

.3 Incomplete shop drawing submissions will be returned without review. Only shop drawings for specific equipment being supplied will be accepted. Generic or standard catalogue data is not acceptable.

.4 Shop drawings to include:

.1 Schematic power and control diagrams showing generator, voltage regulator, metering, battery, battery charger, governor, and all engine/generator protection and controls. Indicate all field connection requirements.

.2 Make and model of engine, generator, governor, voltage regulator, battery charger, battery, exhaust silencer, block heater/thermostat, vibration isolators, control devices, and power components, complete with technical and performance data.

.3 Confirmation that the generator set will comply with 100% shop load performance requirements.

.4 Dimensioned drawings for alternator, engine, control switchboard, and all accessories.

.5 Indication of all anchoring/mounting locations, and all power/control connection locations.

.6 Confirmation that required engine power at 110% rated load condition, 0.8 PF, does not exceed the engine manufacturer's recommended standby power rating.

.7 Manufacturer's published standby power output curves and fuel consumption curves.

.8 Description of set operation including:

.1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit pressures rated voltage and frequency.

.2 Automatic shutdown and alarm on:

.1 Over-cranking

.2 Overspeed

.3 High engine temperature

.4 Low lube oil pressure

.5 Short circuit

.6 Alternator over voltage

.7 Lube oil high temperature.

.3 Over temperature on alternator.

.4 Manual remote emergency stop.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 26 05 00 – Common Work Results for Electrical.

.2 Include in operation and maintenance manual instructions for particular unit supplied and not general description of units manufactured by supplier, and:

.1 Operation and maintenance instructions to permit effective operation, maintenance, and repair for engine, alternator, control panel, automatic transfer switch, manual bypass switch, battery charger, battery, fuel system, generator room, ventilation system, exhaust system, and accessories.

.2 Technical data:

.1 Illustrated parts list with parts catalogue numbers

.2 Schematic diagram of electrical controls

.3 Flow diagrams for:

.1 Fuel system

.2 Lubricating system

.3 Cooling system

.4 Certified copy of factory test results

.5 Maintenance and overhaul instructions and schedules

.6 Precise details for adjustment and setting of time delay relays or sensing controls which require on-site adjustment.

.3 Certified copy of factory test results.

.4 Copy of guarantee.

.5 Complete set of as-built physical, schematic, and wiring diagrams and complete installation instructions.

1.6 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Division 01.

.2 Include:

.1 1 Fuel filter replacement elements

.2 1 Lube oil filter replacement elements

.3 1 Air cleaner filter elements

.4 4 Sets of fuses for control panel

.5 4 of each type of indicating lamps

.6 1 Set of 'fan' belts

.7 1 Set of complete tools for routine servicing.

1.7 SOURCE QUALITY CONTROL

.1 Factory test generator set including engine, alternator, control panel, transfer switch, and accessories.

.2 The generator set and accessories are to be tested and manufactured in accordance with the manufacturer's quality assurance program. The programs shall comply with the intent, or CSA CANS-Z299.3, or ISO 9001. Provide a copy of the manufacturer's quality assurance procedures manual if requested by the Engineer.

.3 Test procedure:

.1 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:

.1 Date and location

.2 Generator set serial number

.3 Engine make, model, and serial number

.4 Alternator make, model, and serial number

.5 Voltage regulator make and model

.6 Rating of generator set, kW, kVA, volts, amps, RPM, Hz.

.2 Mark check sheet and record data on forms in duplicate as test proceeds.

.3 Provide reactive type load bank and related controls to allow testing, including 100% step loads. Provide all necessary instrumentation and recording equipment.

.4 Indicate name of test operator.

.4 Tests

.1 Perform functional and load tests to verify conformance with specifications, codes, and performance requirements.

.2 Tests are to include:

.1 Automatic shutdown devices and trouble alarms. Tests to include actual out-of-limits operation with protective devices in their installed and in-service condition to prove sensor operation within manufacturer's recommended limits. Jumper testing of sensors or remote simulation testing to prove shutdowns are not permissible.

.2 Automatic start-up, transfer to load, transfer back to normal power, cool down, and shutdown.

.3 Demonstrate the battery reverts to high rate charge after cranking.

1.8 WARRANTY

.1 For the diesel engine driven generator set, the 12 month warranty period prescribed in the General Conditions is extended to 60 month or 1500 operating hours, whichever occurs first.

1.9 DELIVERY

.1 Store generator set and accessories in an indoor, dry, heated location until delivered to the site.

.2 Coordinate site delivery so that equipment is off-loaded and immediately placed in a dry indoor location.

.3 Coordinate lifting, handling, and placing requirements of all items.

.4 Site Tests:

.1 With 100% rated load, operate set for 4 h, taking readings at 15 min. intervals, and record the following:

.1 Time of reading

.2 Running time

.3 Ambient temperature in °C

.4 Lube oil pressure in kPa

.5 Lube oil temperature in °C

.6 Engine coolant temperature in °C

.7 Exhaust stack temperature in °C

.8 Alternator voltage: phase 1, 2, 3

.9 Alternator current: phase 1, 2, 3

.10 Power in kW

.11 Frequency in Hz

.12 Power factor

.13 Battery charger current in A

.14 Battery voltage

.15 Alternator cooling air outlet temperature.

.2 Prior to the load test, demonstrate following shutdown devices and alarms:

.1 Over-cranking

.2 Overspeed

.3 High engine temperature

.4 Low lube oil pressure

.5 Short circuit

.6 Alternator over-voltage

.7 Low battery voltage, or no battery charge

.8 Manual remote emergency stop

.9 High alternator temperature.

.3 Prior to the load test, install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:

.1 No load to full load (100%) to no load

.2 No load to 70% load to no load

.3 No load to 20% load to no load

.4 20% load to 40% load to no load

.5 40% load to 60% load to no load

.6 60% load to 80% load to no load.

.4 Demonstrate:

.1 Automatic starting of set and automatic transfer of load on failure of normal power.

.2 Operation of manual bypass switch

.3 Automatic shutdown of engine on resumption of normal power

.4 That battery charge reverts to high rate charge after cranking.

.5 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

Part 2 Products

2.1 GENERAL

.1 Provide one (1) Diesel Engine powered standby generator unit

.2 Each overall output rating 175 kW/ 220 kVA standby (0.8 pf).

.3 Each output voltage 600V, 3 phase, 3 wire;

.4 Note: neutral grounded at the control panel; load side output to transfer switch is 3 wire only.

.5 Manufacturers: Caterpillar, Cummins, MTU or approved equivalent.

2.2 DIESEL ENGINE

.1 Diesel Engine: to ISO 3046/1.

.1 Engine: standard product of current manufacturer, from company regularly engaged in production of such equipment.

.2 Turbo charged, synchronous speed 1800 r/min.

.3 Cooling System:

.1 Liquid cooled: heavy duty industrial radiator mounted on generating set base with engine driven pusher type fan to direct air through radiator from engine side with manufacturer's recommended anti-freeze, non-sludging above minus 46°C.

.2 Block heater: thermostatically controlled lube oil or liquid cooled heater connected to line side of automatic transfer switch to allow engine to start in room ambient 0°C.

.4 Fuel:

.1 Arctic Grade 2: to CGSB 3-GP-6c.

.5 Fuel System: Solid injection, mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.

.6 Fuel lines to be braided hard duty flexible connectors. Standard hoses are not acceptable.

.7 Governor:

.1 Electronic type with electric actuator, speed droop externally adjustable from isochronous to 5% temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.

.8 Lubrication System:

.1 Pressure lubricated by engine driven pump

.2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping

.3 Lube oil cooler

.4 Engine sump drain valve

.5 Oil level dip-stick.

.9 Starting System:

.1 Positive shift, gear engaging starter 12 or 24 V dc

.2 Cranking limiter to provide 6 cranking periods of 10 s duration, each separated by 5 s rest.

.3 Lead acid, 12 or 24 V storage battery with sufficient capacity to crank engine for 1 min. at 0°C without using more than 25% of ampere hour capacity.

.4 Two CSA approved jacket water heaters with thermostatic control to maintain engine temperature at a sufficient level to maintain normal engine starting temperatures.

.5 Battery Charger: constant voltage, solid state, two stage from trickle charge at standby to boost charge after use. Regulation: plus or minus 2% output for plus or minus 10% input variation. Equipped with dc voltmeter, de ammeter, and on-off switch. Minimum charger capacity: 7 A.

.10 Vibration Isolation Engine Instrument Panel with:

.1 Lube oil pressure gauge

.2 Lube oil temperature gauge

.3 Coolant temperature gauge

.4 Coolant level gauge

.5 Running time meter: non-tamper type.

.11 Guards to protect personnel from hot and moving parts. Locate guards so that normal daily maintenance inspections can be undertaken without their removal.

.12 Drip tray.

2.3 ALTERNATOR

.1 Alternator: to ANSI/NEMA MG1.

.2 Rating: 3 phase, 600 V, 3 wire, 220 kVA, 60 Hz, at 0.8 PF.

,3 Output at 40°C ambient:

.1 100% full load continuously

.4 Revolving field, brushless, single bearing., 4 pole, revolving field.

.5 Drip-proof.

.6 Amortisseur windings.

.7 Synchronous type.

.8 Exciter: permanent magnet.

.9 EEMAC class H insulation of windings.

.10 Platinum resistance temperature transducers embedded in stator winding and connected to alternator control circuitry.

.11 Voltage regulator: thyristor controlled rectifiers with phase controlled sensing circuit:

.1 Stability: 0.5% maximum voltage variation at any constant load from no load to full load.

.2 Regulation: 1.5% maximum voltage deviation between no-load steady state and full load steady state.

.3 Transient: 10% maximum voltage dip on one-step application of 0.8 PF full load.

.4 Transient: 12% maximum voltage rise on one-step removal of 0.8 PF full load.

.5 Transient: 1 s maximum voltage recovery time with application or removal of 0.8 PF full load.

.12 Alternator: capable of sustaining 300% rated current for period not less than 10 s permitting selective tripping of down line protective devices when short circuit occurs.

2.4 CONTROL PANEL

.1 Totally enclosed, unit mounted on the alternator with vibration isolation.

.2 Instruments:

.1 Digital 100% solid state circuitry indicated type 2 % accuracy rectangular face, flush panel mounting:

.1 Voltmeter: ac, scale 0 to 650 V

.2 Ammeter: ac, scale 0 to 200 A

.3 Wattmeter: scale 0 to 60 kW

.4 Frequency meter: scale 55 to 65 Hz

.5 kVAR meter

.6 kW/h meter.

.2 Voltmeter selector switch, four position, labelled "Off-Phase A-Phase B-Phase C".

.3 Controls:

.1 Engine start button

.1 Selector switch: Off-Auto-Manual – Test full load - test no load.

.2 Engine emergency stop button and provision for remote emergency stop button.

.2 Alternator Output Breaker:

.1 Circuit Breaker: bolt-on, moulded case, temperature compensated for 40°C ambient, dual thermal-magnetic trip.

.3 Voltage control rheostat: mounted on the inside of the control panel.

.4 Operating lights, panel mounted:

.1 "Normal power" pilot light

.2 "Emergency power" pilot light

.3 Green pilot lights for breaker on and red pilot lights for breaker off.

.5 Solid state indicator lights for alarm with 2 sets manually resent NO/NC contacts wired to terminal block for remote annunciation on:

.1 Low fuel level

.2 Low battery level

.3 Ventilation failure

.4 Low coolant temperature.

.6 Solid state controller for automatic shutdown and alarms with 2 sets manual reset NO/NC contacts wired to terminal block for remote annunciation on:

.1 Engine over-crank

.2 Engine overspeed

.3 Engine high temperature

.4 Engine low lube oil pressure

.5 Short circuit

.6 AC over-voltage.

.7 Lamp test button.

.8 Provision for remote monitoring.

2.5 AUTOMATIC TRANSFER SWITCH

.1 Refer to Section 26 36 23 - Automatic Transfer Switch.

2.6 BATTERY CHARGER

.1 Battery charger shall be a silicon controlled rectifier type (thyristor) for automatic float charge operating from 120 Volts, single phase, 60 Hz supply. Charger shall be automatic two-rate type with the following components and features.

.1 Float and equalizer voltage adjustments.

.2 Adjustable current limit control.

.3 Equalize circuit.

.4 Overload protected input switch.

.5 D.C. output breaker.

.6 D.C. ammeter.

.7 D.C. voltmeter.

.8 Short-circuit current limit protection.

.9 Reverse polarity protection.

.10 Temperature compensation.

.2 Output Voltage, 24 V DC, within +/- 0.5% steady state - with input voltage variation +/- 10% from 10% to 100% load.

.3 Alarm/Status - Indicating annunciator with indicators for:

.1 AC power on - status only.

.2 AC power off - alarm.

.3 Float and equalize - status only.

.4 Reverse polarity - alarm.

.5 Voltage Limit - alarm.

.6 Current Limit - alarm.

.4 Alarm contacts (2) for remote monitoring of battery system alarms.

.5 The battery charger shall be capable of recharging the battery when completely discharged to 80% of capacity within four hours and to full capacity within 12 hours.

.6 Battery charger shall be mounted in a ventilated enclosure suitable for wall mounting.

2.7 STEEL MOUNTING BASE

.1 Complete generating set mounted on structural steel base with fuel tank of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation, and under operating conditions on suitable level surface.

.2 Assembly fitted with vibration isolators and control console resiliently mounted.

.1 Spring-type isolators with adjustable side snubbers and adjustable for levelling.

.3 Sound insulation pads for installation between isolators and concrete base.

2.8 EXHAUST SYSTEM

.1 Heavy duty critical grade, Cowl, spiral chamber exhaust.

.2 Heavy duty flexible exhaust pipe with flanged couplings as required.

.3 Fittings and accessories as required.

.4 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.

2.9 FUEL DAY TANK SYSTEM

.1 Dual wall, integral with base with all accessories to meet regulations both National and Territorial.

.2 Capacity: 12 hours continuous operation at full load.

.3 The fuel tank shall be equipped with electronic fuel level sensors with remote indicator display in litres. Sensor to also signal generator control panel to identify fuel low-level and shut down the generator.

.4 Provide duel contact device in interstitial space of double wall tank to monitor for fuel leaks. One set of contacts to be connected to generator control panel to indicate fuel leak, second contact to be used and connected to fuel transfer pump control panel provided by Division 23.

.5 In addition to the generator supply and return fuel line connections, interstitial space vent and sensor opening in the sub base day tank. The following threaded hubs for piping and sensors shall be provided:

.1 Four (4) NPS-1.

.2 Two (2) NPS-2.

2.10 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Alternator control cubicle: paint inside, exterior to match engine and alternator.

.3 Other ducts and racks: grey.

.4 Supply 0.25 L of touch-up enamel.

2.11 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Control Panel:

.1 Nameplates for controls such as alternator breakers and program selector switch.

.2 Nameplates for meters, alarms, indicating lights, and minor controls.

2.12 FABRICATION

.1 Shop assemble generating unit including:

.1 Base

.2 Engine and radiator

.3 Alternator

.4 Control panel

.5 Battery and charger

.6 Automatic transfer equipment.

2.13 MANUFACTURER

.1 Onan, Kohlerm , Cummins, Cat.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 - Testing, Verification, Commissioning and Training Electrical Systems and as specified herein.

.2 Operation of all components to be demonstrated – battery charger, alarm devices, transfer switch, block heaters, controls, and all other components making up the overall system.

.3 Using a resistive load bank, 100% of alternator rating, perform a functional test of all equipment and record the following:

.1 Engine oil pressure

.2 Water temperature

.3 Cranking time to start

.4 Time to achieve standby power operation

.5 Time delay on start

.6 Time delay on retransfer to normal

.7 Voltage current, every 15 minutes, for 1 hour.

.4 Perform a full load acceptance test, using a 110% rated resistive load bank, as follows:

.1 100% rated kW load (at 100% PF) for 4 hours.

.2 If the generator system fails testing, make any necessary adjustments or repairs and repeat testing for 4 hours at 100% load.

.3 The above on-site tests are to be carried out only after the unit has been verified in writing by the manufacturer or his representative as being installed and assembled correctly and all associated components and utilities are properly connected.

.4 Include all fuel costs for testing in tender, and upon completion of testing, leave tanks filled to capacity.

.5 Observe and document voltage, current, oil pressure, water temperature, and frequency at 15 min. intervals.

.5 Upon completion of successful testing, arrange and pay for demonstration and training to the Owner by an authorized factory representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.190-2014, Capacitors for Power Factor Correction.

.2 Underwriters' Laboratories Inc. (UL)

.1 UL 1449-2014, Surge Protective Devices

.3 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE C62.41-2002, IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.

.3 Submit certified test results to Engineer.

.4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Instructions: submit manufacturer's installation instructions.

.1 Engineer will make available 1 copy of systems supplier's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 POWER QUALITY REGULATOR

.1 Surge protective device included, complies with ANSI/IEEE C62.41, UL 1449.

.2 Regulator characteristics:

.1 150 kVA.

.2 600 V, three phase, 60 Hz input/output voltage.

.3 No regulation variation required on variable loads.

.4 Overload capability:

.1 6000% - 1 cycle;

.2 1000% - 1 second;

.3 500% - 5 seconds;

.4 200% - 1 minute.

.5 Fault clearing capability: 1000%.

.6 97% efficient isolation transformer design.

.7 Response time within 1 cycle.

.8 Copper wound transformer.

.9 No minimum load or part-load limitations.

.10 Compatible with all load types, including all load power-factors.

.11 Operable at 0 to 40 degrees Celsius, 0-95% relative humidity.

.12 Enclosure: indoor NEMA 1 enclosure.

.13 Floor mounted.

2.2 FINISH

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.

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 Install and connect power quality regulator as per manufacturer’s instructions.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Carry out following tests by manufacturer within 24 hours of energizing equipment:

.1 Voltage, current and frequency are balanced and within unit rating.

.2 Operating kVA.

.3 Provide certified test results to Engineer.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results for Electrical.

.2 Section 26 29 03 – Control Devices.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN3-C13-M83 (R2003), Instrument Transformers.

.2 CSA C22.2 No.178-1978 (R2006), Automatic Transfer Switches.

.2 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)

.1 ANSI/NEMA ICS 2:2000 (R2009), Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated 600 Volts.

1.3 SYSTEM DESCRIPTION

.1 Automatic load transfer equipment to:

.1 Monitor voltage on phases of normal power supply.

.2 Initiate cranking of the generator on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.

.3 Transfer load from normal supply to the generator when the generator reaches rated frequency and voltage pre-set adjustable limits.

.4 Transfer load from the generator to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.

.5 Shut down generator after running unloaded to cool down using adjustable time delay relay.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Include:

.1 Make, model and type.

.2 Single line diagram showing controls and relays.

.3 Description of equipment operation including:

.1 Signal for automatic starting and transfer to generator and back to normal power.

.2 Test control.

.3 Manual control.

.4 Signal for shutdown.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

.2 Detailed instructions to permit effective operation, maintenance and repair.

.3 Technical data:

.1 Schematic diagram of components, controls and relays.

.2 Illustrated parts lists with parts catalogue numbers.

.3 Certified copy of factory test results.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal all packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Engineer.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 MATERIALS

.1 Instrument transformers: to CAN3-C13.

.2 Contactors: to ANSI/NEMA ICS2.

2.2 TRANSFER EQUIPMENT

.1 Transfer Equipment: to CSA C22.2 No.178.

.2 1 phase load rated switch units with arc chutes mounted on common frame, in a double throw arrangement, single motor solenoid operated.

.3 Rated: 600 V, 60Hz, 3 phase, 3 pole, 3 wire, size as indicated on drawings.

.4 Main contacts: silver surfaced, protected by arc disruption means.

.5 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel.

.6 Auxiliary contact: to initiate emergency generator start-up on failure of normal power.

.7 Fault withstand rating: 25,000 symmetrical rms Amperes for 3 cycles with maximum peak value of 2.0 times the rms symmetrical value on any phase.

.8 Lever to operate switch manually when switch is isolated.

.9 Transfer switch operation to include an adjustable delay feature on the solenoid operation of the transfer to achieve a null position in the transfer. This feature is required to allow the residual field in transformers and the back EMF in motors to decay transient to reduce current and voltage affects due to load transfer.

2.3 CONTROLS

.1 Selector switch - four position "Test", "Auto", "Manual", "Engine run". *Note: these switch positions are to be integrated with the selector switch positions in the control panel located in the remote engine/generator control panel.*

.1 Test position - Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.

.2 Auto position - Normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.

.3 Manual position - Transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.

.4 Engine start position - Engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

.2 Control transformers: dry type with 120V secondary to isolate control circuits from:

.1 Normal power supply.

.2 Emergency power supply.

.3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:

.1 Voltage sensing: 2 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2V minimum undervoltage protection.

.2 Time delay: normal power to generator, adjustable solid state, 0 to 60s.

.3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 3 to 20s delay.

.4 Time delay on retransfer from generator to normal power, adjustable 0 to 60s, 5 to 180s.

.5 Time delay signal to allow engine cool to after retransfer to normal power down, adjustable solid state, 20s intervals to 10 min.

.6 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 0 intervals to 5 minutes.

.7 Frequency sensing, to prevent transfer from normal power supply until frequency of generator reaches preset adjustable values.

2.4 ACCESSORIES

.1 Pilot lights to indicate power availability normal and generator , switch position, green for normal, red for generator , mounted in panel; auxiliary terminals for remote.

.2 Auxiliary relay to provide 4 N.O. and 4 N.C. contacts for remote alarms indication of transfer switch position.

.3 Instruments:

.1 Meter – multi-function digital true rms, indicating type 2% accuracy, flush panel mounting:

.1 Voltmeter: ac, scale 0 to 750 V.

.2 Ammeter: ac, scale 0 to 25% above rated current.

.3 Frequency meter: scale 55 to 65 Hz.

.4 Ammeter selector switch: rotary, maintained contacts, panel mounting type, designed to prevent opening of current circuits, round notched handle, four position labelled "OFF - Phase A - Phase B - Phase C".

.5 Current transformers - dry type for indoor use:

.1 Ratio: Amperage as indicated and to suit metering.

.2 Rating: 750 V, 60Hz, BIL 10 kV.

.3 Accuracy rating: revenue metering.

.4 Positive action automatic short- circuiting device in secondary terminals.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.6 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.

.2 Notify Engineer seven (7) days in advance of date of factory test.

.3 Tests:

.1 Operate equipment both mechanically and electrically to ensure proper performance.

.2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.

.3 Check voltage sensing and time delay relay settings.

.4 Check:

.1 Automatic starting and transfer of load on failure of normal power.

.2 Retransfer of load when normal power supply resumed.

.3 Automatic shutdown.

Part 3 Execution

3.1 INSTALLATION

.1 Locate, install and connect transfer equipment.

.2 Check relays solid state sensors and adjust as required.

.3 Install and connect remote alarms and signals.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Prior to the on-site engine generator testing, confirm all field control and power wiring is correct between each of the two(2) transfer switches and the remote control panel. Verify by simulating functional tests.

.3 Set selector switch in "Test" position to ensure proper generator start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure generator shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open normal power supply disconnect. Generator should start, come up to rated voltage and frequency, and then load should transfer to generator. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to normal power supply and generator should shutdown.

.7 Repeat test sequence at 30 minute intervals, at least twice for each transfer switch. Complete test with selector switch in each position, for each test.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Supply and install lighting fixtures complete with lamps, ballasts and all necessary fittings.

1.2 CODE REQUIREMENTS

.1 Installation of lighting equipment to conform to Section 30, Canadian Electric Code, Part 1, and as amended or supplemented by provincial, municipal or other regulatory agencies having jurisdiction.

.2 All lighting levels shall conform to the Illuminating Engineering Society (IES) requirements.

1.3 SHOP DRAWINGS

.1 Submit a complete list of the types of lighting fixtures, lamps, ballasts and accessories with catalogue illustrations, data sheets, etc. for review.

.2 Submit complete photometric data, based on actual fixtures proposed for project. Substantiate brightness and efficiency requirements. Photometric data must be produced by a recognized independent laboratory.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 GENERAL

.1 Provide, wherever possible, commercially available stock lighting fixtures meeting specified requirements and as shown on the drawings.

.2 Different fixtures may be supplied by different manufacturers. Similar fixtures shall be supplied by the same manufacturer.

.3 Provide only lighting fixtures which are structurally well designed and constructed and which use new parts and materials of highest commercial grade available. Unless otherwise specifically noted, fixtures shall be of the quality stated in the manufacturer's catalogues and data sheets.

.4 Refer to drawing luminaire schedule for details of fixtures and accessories.

.5 Use cadmium plated chains for suspended fixtures.

Part 3 Execution

3.1 INSTALLATION

.1 Install fixtures in accordance with the manufacturer's requirements, code requirements, and as shown on the drawings.

.2 Ground lighting equipment with a separate grounding conductor.

.3 Co-ordinate with other trades to avoid conflicts between luminaires, supports and fittings and mechanical and structural equipment.

.4 Provide guards where fixtures are subject to mechanical damage as required by code or shown on the drawings.

3.4 WORKMANSHIP

.1 Completely clean all glassware, lamps, and hangers. Polish metal parts before completion.

.2 Provide suitable extension couplings for row mounted fixtures.

.3 Protect fixtures, hangers, supports, fastenings and accessory fittings at the site prior to and during installation. Unless fixtures are erected immediately, after delivery to site, deliver in original cartons or enclosed in air-tight plastic wrapping. Store in a dry and secure space on site. Protect hangers, supports, fastenings and accessory fittings against corrosion. Take care during installation to ensure that insulation and corrosion protection is not damaged.

.4 Fixtures, which show evidence of corrosion, rough handling, scratching of finishes, etc. are to be replaced with new fixtures at no additional cost.

.5 Hang and mount fixtures to prevent distorting fixture frame, housing, sides or lens frame, and permit correct alignment of several fixtures in a row.

.6 Remove any noisy and faulty ballasts from the fixtures and replace at no additional cost to the Owner prior to completion.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Supply emergency lighting units complete with all accessories.

1.2 SPECIAL CODES

.1 Canadian Electric Code, Part 1, Section 46 "Emergency Systems, Unit Equipment and Exit Signs".

.2 CSA Standard C22.2 No. 141-10 (R2015), Unit Equipment for Emergency Lighting.

.3 National Building Code of Canada 2010.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Data to indicate system components, mounting method, source of power and special attachments.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

Part 2 Products

2.1 GENERAL

.1 Supply and install battery power emergency lighting where shown on the drawings. Lights are to switch "ON" automatically in the event of failure of normal power, and "OFF" on restoration of power. The batteries shall be automatically recharged from a 120 VAC supply.

2.2 EQUIPMENT

.1 Acceptable manufacturers: Lumacell, Redi-Lite or Emergi-Lite.

.2 Supply voltage: 120 VAC.

.3 Output voltage: 24 VDC.

.4 Wattage: 432 watts for 30 min.

.5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.

.6 Solid state transfer circuit.

.7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.8 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.9 Lamp heads: integral on unit and remote as indicated on drawing, 345° horizontal and 180° vertical adjustment. Lamp type: MR16-LED-6W.

.10 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.11 Auxiliary equipment:

.1 Test switch

.2 Time delay relay

.3 Battery disconnect device

.4 output terminal blocks inside cabinet.

2.3 REMOTE HEADS

.1 Remote heads in service area standard type.

2.4 LINE CONNECTION

.1 Each battery unit shall be equipped with AC line cord and plug.

2.5 BATTERIES

.1 Unless specifically indicated provide batteries of sufficient watt-hour capacity to power the loads connected to each individual unit for 60 minutes, 12 volt, long life, maintenance free, sealed lead acid batteries, contained within the units.

2.6 WIRING OF REMOTE HEADS

.1 Conduit: type, to Section 26 05 34- Conduits, Conduit Fastenings and Conduit Fittings.

.2 Conductors: RW90 type to Section 26 05 21 - Wires and Cables (0-1000 V), sized in accordance with manufacturer's recommendations.

Part 3 Execution

3.1 INSTALLATION

.1 Mount battery units with the bottom of the enclosure not less than 2.2 m above the floor, where practicable.

.2 Install duplex receptacle adjacent to unit and connect to 10, 120V unswitched area lighting circuit.

.3 Wiring from units to remote heads and/or exit lights shall be sized to prevent voltage drop of more than 5%.

.4 All emergency heads shall be properly aimed.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

.1 Submit duct data in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 STANDARD UNITS

.1 Housing: cold rolled steel minimum 1.0 mm thick, satin white enamel finish.

.2 Face and back plates: die formed cold rolled steel

.3 Lamps: LED-2W 120 VAC x AC/24 VDC.

.4 Operation: designed for 25 years of continuous operation without relamping.

.5 Exit Signs: Full height green running man symbol on white door background in an overall green background with full height directional white arrow in front of the running man on the same overall green background. To be in compliance with the National Building Code 2015 requirements.

.6 Face plate to remain captive for relamping.

.7 Universal mounting.

Part 3 Execution

3.1 INSTALLATION

.1 Install exit lights.

.2 Connect fixtures to exit light circuits.

.3 Ensure that exit light circuit breaker is locked in on position.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 77 00 – Closeout Procedures.

.3 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.46-13 Electric Air-Heaters.

1.3 PRODUCT DATA

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

.2 Submit product data sheets for unit heaters. Include:

.1 Product characteristics.

.2 Performance criteria.

.3 Mounting methods.

.4 Physical size.

.5 kW rating, voltage, phase.

.6 Cabinet material thicknesses.

.7 Limitations.

.8 Colour and finish.

.3 Submit product data sheets for unit heaters.

.1 Include product characteristics, performance criteria, physical size, limitations and finish.

.4 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Engineer.

Part 2 Products

2.1 UNIT HEATERS

.1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.

.2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.

.3 Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.

.1 Built-in fan motor thermal overload protection.

.4 Hangers: as indicated.

.5 Elements: mineral insulated copper coated steel sheath with aluminum brazed fins.

.6 Cabinet: aluminum, fitted with brackets for rod or wall mounting.

.1 Phosphatized and finished with coats baked enamel in colour.

2.2 CONTROLS

.1 Built in low voltage control relay.

Part 3 Execution

3.1 INSTALLATION

.1 Suspend unit heaters from ceiling or mount on wall as indicated.

.2 Connect to control panel as indicated.

.3 Make power and control connections.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Test cut-out protection when air movement is obstructed.

.3 Test fan delay switch to assure dissipation of heat after element shut down.

.4 Test unit cut-off when fan motor overload protection has operated.

.5 Ensure heaters and controls operate correctly.

END OF SECTION

Part 1 General

1.1 References

.1 Government of Nunavut Community and Government Services (CGS-IPS) Structured Cabling Guidelines Version 1.7 2015.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Engineer.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 POLYETHYLENE INSULATED CABLES

.1 Conductors 22 AWG soft copper made into cables as follows:

- .1 Number of pairs: two (2)
- .2 Polyethylene, electric grade insulation.
- .3 Non-hygroscopic coloured binders.
- .4 Sheath:
  - .1 Flat aluminum tape formed longitudinally and lapped with outer jacket of extruded polyethylene.
  - .2 Inner polyethylene jacket, flat aluminum tape and outer polyethylene jacket.
  - .3 Inner polyethylene jacket, corrugated aluminum tape not overlapped, and soldered, with covering of thermoplastic compound and jacket of polyethylene.
  - .4 Inner polyethylene jacket, layer of spirally wound paper tape and extruded lead sheath.
- .5 Protective covering:
  - .1 Aerial tape armour of galvanized steel tape.
  - .2 Buried tape armour of steel tape, asphaltic compound, and two layers of coal tar anthracene oil impregnated jute.
  - .3 Light wire armour of galvanized steel armour wire over cutched jute, covered by two successive layers of asphaltic compound and coal tar anthracene oil impregnated jute.

.4 Single wire armour of two successive layers of asphaltic compound and coal tar anthracene oil impregnated jute, heavy galvanized steel armour wire and outer covering of asphaltic compounds and two layers of coal tar anthracene oil impregnated jute, with overall layer of asphaltic compound.

.5 Double wire armour of two layers of asphaltic compound and coal tar anthracene oil impregnated jute, two layers of heavy galvanized steel armour wire separated by layer of asphaltic compound and overall covering of two successive layers of asphaltic compound and coal tar anthracene oil impregnated jute.

2.2 TELEPHONE WIRE

.1 All structured wiring must conform to the Government of Nunavut Community and Government Services (CGS-IPS) Structured Cabling Guidelines Version 1.7 2015.

.2 Drop wire: two parallel 0.98 mm, solid, 30% conductivity high strength copper covered steel, lead coated brass plated conductors with styrene butadiene rubber insulation and neoprene jacket, designed for aerial drops from poles to buildings.

.3 Heavy duty drop wire: two No. 14 AWG solid hard drawn copper, lead coated, brass plated conductors with styrene butadiene rubber insulation, neoprene jacket twisted in to pair, designed to connect open wire line to cable terminals.

.4 Multiple drop wire: twelve No.22 AWG solid annealed copper conductors with polyethylene insulation made into six twisted pairs cabled together laid parallel to messenger of 6.16 mm^2 grade 130 electrogalvanized steel wire and jacketted in form of figure 8 with low temperature polyvinyl chloride, for aerial drop from poles to multiple dwellings.

.5 Service wire: four No. 22 AWG solid annealed copper conductors with polyethylene insulation, spiral four lay-up, inner jacket polyvinyl chloride, close serving of flat galvanized steel wire armour, outer jacket of polyvinyl chloride designed for buried service connections.

.6 Underground wire: two No.19 AWG solid annealed copper conductors laid parallel, polyethylene insulation, close serving of flat galvanized steel wire armour, jacket of polyvinyl chloride designed for buried service connections.

.7 Ground wire: one No. 14 AWG solid annealed copper conductor with polyvinyl chloride insulation designed for ground connections to protect cable terminals and protectors.

2.3 AUTODIALER

.1 Provide an 8 input, 16 output autodialer capable of connecting to the RJ11 telephone connection.

.2 Input power: 11.5 to 28VDC.

.3 Manufacturer: Bentek Systems Protalk Series or approved equivalent.

.4 Autodialer to have battery backup rated for 24hrs of operation.

Part 3 Execution

3.1 INSTALLATION

.1 Install telephone wires on pole line by:

- .1 Stringing conductors over cross arms.
- .2 Fasten conductors to insulators on first pole.
- .3 Tighten conductors to achieve correct sag.
- .4 Fasten conductors progressively to insulators on poles until last pole in run is reached.

.2 Install telephone drop wires from pole lines to buildings using drop wire hooks and cable clamps at pole and at building.

.3 Install coaxial drop wire from terminal block on pole to building, as indicated, using drop wire hooks and cable clamps at pole and at building.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Section 26 05 21 - Wires and Cables (0-1000 V).

.2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

.1 Underwriters Laboratories' of Canada (ULC)

.1 CAN/ULC-S524-14, Standard for the Installation of Fire Alarm Systems.

.2 CAN/ULC-S525-16, Audible Signal Appliances for Fire Alarm Systems.

.3 CAN/ULC-S526-07, Visual Signal Appliances for Fire Alarm Systems.

.4 CAN/ULC-S527-11 AMD-1(2014), Standard for Control Units for Fire Alarm Systems.

.5 CAN/ULC-S528-14, Manual Pull Stations for Fire Alarm Systems.

.6 CAN/ULC-S529-09, Smoke Detectors for Fire Alarm Systems

.7 CAN/ULC-S530-91 (R1999), Heat Actuated Fire Detectors for Fire Alarm Systems.

.8 CAN/ULC-S531-14, Standard for Smoke Alarms.

.9 CAN/ULC-S536-13, Inspection and Testing of Fire Alarm Systems.

.10 CAN/ULC-S537-13, Verification of Fire Alarm Systems.

.2 CSA Canadian Standards Association (CSA International)

.1 C22.1 Section 32, Fire Alarm Systems and Fire Pumps

.3 NBC, National Building Code of Canada

.4 Local Building Code.

1.3 DESCRIPTION OF SYSTEM

.1 System includes:

.1 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.

.2 Trouble signal devices.

.3 Power supply facilities.

.4 Manual alarm stations.

.5 Automatic alarm initiating devices.

.6 Audible signal devices.

.7 End-of-line devices.

.8 Annunciators.

.9 Visual alarm signal devices.

.10 Ancillary devices.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Include:

.1 Layout of equipment.

.2 Zoning.

.3 Complete wiring diagram, including schematics of modules

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual specified in Section 26 05 00 – Common Work Results for Electrical.

.2 Include:

.1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings.

.4 List of recommended spare parts for system.

1.6 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Division 1 – Maintenance Materials, Special Tools and Spare Parts.

.2 Include:

.1 2 spare glass rods for manual pull box stations if applicable.

.2 1 rate of rise heat detector.

.3 1 pull station

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management Plan.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Engineer.

1.8 TRAINING

.1 Arrange and pay for one on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system. Seminars will use actual demonstration.

.2 A representative from the manufacturers shall attend the seminar.

Part 2 Products

2.1 MATERIALS

.1 Equipment and devices: ULC listed and labeled and supplied by single manufacturer.

.2 Acceptable Manufacturers: Simplex, Edwards or Notifier.

.3 Power supply: to CAN/ULC-S524.

.4 Audible signal devices: to ULC-S525.

.5 Visual signal devices: to CAN/ULC-S526.

.6 Control unit: to CAN/ULC-S527.

.7 Manual pull stations: to CAN/ULC-S528.

.8 Thermal detectors: to CAN/ULC-S530.

.9 Smoke detectors: to CAN/ULC-S529.

2.2 SYSTEM OPERATION

.1 Single stage operation. Operation of any alarm initiating device to:

.1 Cause audible signal devices to sound throughout building.

.2 Transmit signal to fire department via auto dialer provided through Division 27.

.3 Cause zone of alarm device to be indicated on control panel.

.4 Cause air conditioning and ventilating fans to shut down or to function so as to provide required control of smoke movement.

2.3 CONTROL PANEL

.1 Class B.

.2 Single stage operation.

.3 Zoned.

.4 Non-coded.

.5 Enclosure: CSA Enclosure 1, c/w lockable concealed hinged door, full viewing window, flush lock and 2 keys. Enclosure to be suitable for surface wall mounting.

.6 Supervised, modular design with plug-in modules:

.1 Alarm receiver with trouble and alarm indications for class B initiating circuit.

.2 Provide one (1) initiating zone for each detection device plus four (4) spares.

.3 Spare zones: compatible with smoke detectors and open circuit devices.

.4 Minimum of two (2) signal circuits with capacity for strobe light operation.

.5 Space for future modules.

.6 Latching type supervisory receiver circuits. Discrete indication for both off-normal and trouble.

.7 Components:

.1 Coded alarm receiver panel with trouble and alarm indications for class B initiating circuit.

.2 Single stage alarm pulse rate panels:

.1 Single stroke control type for output to signal control panel continuously.

.3 Common control and power units:

.1 Control panel containing following indications and controls:

.1 "Power on" LED (green) to monitor primary source of power to system.

.2 "Power trouble" indication.

.3 "Ground trouble" indication.

.4 "Remote annunciator trouble" indication.

.5 "System trouble" indication.

.6 "System trouble" buzzer and silence switch c/w trouble resound feature.

.7 System reset switch.

.8 "LED test" switch if applicable.

.9 "Alarm silence" switch to silence signals manually. If new alarm occurs after signals have been silenced, signals to resound.

.10 "Signals silenced" indication.

.2 Master power supply panel to provide 24 V dc to system from 120 V ac, 60 Hz input.

.3 Fire department connections:

.1 Fire department bypass switch c/w indicator for trouble at panel.

.4 Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit and c/w bypass switch.

.1 Contacts: 2.0 A, 120 V ac, for initiation of fan shut down.

.2 Contact terminal size: capable of accepting 22-12 AWG wire.

2.4 POWER SUPPLY

.1 120 V, ac, 60 Hz input, 24 V dc output from rectifier to operate alarm and signal circuits. Power supply from 120 /208 V local emergency power panel. Include surge protection on incoming power wiring.

.2 Battery unit with automatic battery charger to provide supervisory and trouble signal current for 24 hours, plus general alarm load for minimum of five minutes, complete with voltmeter and charging meter. Unit to be sized to carry the complete fire alarm system.

2.5 MANUAL ALARM STATIONS

.1 Manual alarm stations: pull lever, glass rod, wall mounted surface type, non-coded single pole normally open contact for single stage English signage.

.2 Manual station in hazardous location to be explosion proof.

2.6 AUTOMATIC ALARM INITIATING DEVICES

.1 Heat detectors, fixed temperature, non-restorable, rated 88°C.

.2 Thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C, rate of rise 8.3°C per minute.

.3 Thermal fire detectors in hazardous area to be explosion proof.

.4 Smoke detector: ionization

.1 Twistlock Plug-in type with fixed base.

2.7 AUDIBLE SIGNAL DEVICES

.1 Horns: 90 dB, surface mounting, 24 V dc c/w visual alarm device.

2.8 END-OF-LINE DEVICES

.1 End-of-line devices to control supervisory current in alarm circuits and signaling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.9 VISUAL ALARM SIGNAL DEVICES

.1 Strobe type: flashing, white 24 V de.

.2 Designed for surface mounting in combination with audible signal device as indicated.

2.10 AS-BUILT RISER DIAGRAM

.1 Fire alarm system riser diagram: in glazed frame, minimum size 600 x 600 mm.

2.11 ANCILLARY DEVICES

.1 Remote relay unit to initiate fan shutdown.

Part 3 Execution

3.1 INSTALLATION

.1 Install systems in accordance with CAN/ULC-S524 and TB OSH Chapter 3-4.

.2 Install main control panel and connect to ac power supply, de standby power.

.3 Locate and install manual alarm stations and connect to alarm circuit wiring.

.4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors.

.5 Connect alarm circuits to main control panel.

.6 Locate and install audible signal and visual signal devices and connect to signaling circuits.

.7 Connect signaling circuits to main control panel.

.8 Install end-of-line devices at end of alarm and signaling circuits, in a separate box not more than 1730 mm above finished floor.

.9 Locate and install remote relay units to control fan shut down.

3.2 WIRING

.1 Ensure conductors are routed in such a manner to provide required fire rating.

.2 Signal circuits to be wired with a minimum 2 - #14 R90 per zone. In no case shall the voltage drop to any signal exceed 10%.

.3 Alarm initiating devices to be wired with multi conductor #18 R90 cables as required in accordance with the Canadian Electrical Code. Circuit resistance shall not exceed 50 ohms.

.4 All wiring will be terminated into the terminal strips in the fire alarm cabinet with all wiring fully labeled. All cabling to be neat with cables bundled and wrapped inside the cabinets. No splicing will be allowed within the cabinets. A complete schedule of all wiring terminations will be mounted inside each control unit. A complete schematic with all devices, cable labeling information, destinations, etc. will be included with the shop drawings.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 02 - Testing, Verification, Commissioning and Training of Electrical Equipment and System and CAN/ULC-S537.

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors transmit alarm to control panel and actuate general alarm.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of system.

.4 Class B circuits.

.1 Test each conductor on all circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on all circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

3.4 VERIFICATION AND CERTIFICATION

.1 The manufacturer shall make an inspection of the fire alarm equipment, including those components necessary to the direct operation of the system such as detectors and controls, whether or not manufactured by the manufacturer added under this contract. The inspector shall comprise an examination of such equipment for the following.

.1 That the type of equipment installed is that designated by the specification.

.2 That the wiring connections to all equipment components show that the installer undertook to have observed ULC and CSA requirements.

.3 That equipment of the manufacturer's manufacture has been installed in accordance with the manufacturer's recommendations and that all signaling devices of whatever manufacture have been operated or tested to verify their operation.

.4 That the supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the governmental regulations, if any, concerning such supervisory wiring have been met to the satisfaction of inspecting officials.

.5 To assist the contractor in preparing his bid the manufacturer shall indicate the number of hours necessary to complete this inspection prior to closing of tenders, and the number of hours necessary to provide a seminar on the system for the building Owner.

.2 The system shall be tested and verified according to requirements of CAN/ULC-S537 Standard for Verification of Fire Alarm System Installations. The complete verification procedure will be under the control and supervision of the Engineer. The services of the contractor and representatives of the fire alarm manufacturer are required for the verification. The following is a rough breakdown of the responsibilities of each part participating in the verification. The following is a rough breakdown of the responsibilities of each party participating in the verification. This list does not necessarily note all the required work. The contractor and fire alarm manufacturer shall provide equipment and manpower as necessary to complete the verification to the Engineer's requirements and approval.

.3 Contractor:

.1 Remove/reinstall devices

.2 Activate alarms

.3 Activate trouble alarms

.4 Provide 1 pair of radios

.5 All work to be 100% complete

.6 Provide necessary manpower

.7 Correct deficiencies

.8 Coordinate and schedule verification (all two weeks’ notice

.4 Manufacturer:

.1 Ensure correct operation of all alarms, signals, auxiliary functions, trouble indication

.2 Record all data and issue report and certificate of verification

.3 Correct any deficiencies

.4 Check, calibrate, adjust and confirm correct operation of control panels, annunciator

.5 Generally assure that all aspects of system function properly

.6 Provide all test equipment, including sound pressure level meter, volt meter, aerosol test smoke.

.5 Engineer:

.1 Direct and supervise verification

.2 Check and ensure that system is applied and installed to all applicable codes

.3 Review test documentation, give to the owner and fire authorities.

.6 All costs involved in this inspection, including manufacturer's, Electrical Contractor's and the Engineer, shall be included in total price. Submit the cost for this verification to be applied to a cost allowance.

.7 Inspection Certification: On completion of the inspection and when all of the above conditions have been complied with, the manufacturer shall issue to the Interior Designer:

.1 A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.

.2 A certificate of verification confirming that the inspection has been completed and showing the conditions upon which such inspection and certification have been rendered.

.3 Seal the certificate with the seal of a Professional Engineer registered in the Northwest Territories.

.4 Proof of liability insurance for the inspection.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Specifications for aggregates and soils and the compaction of aggregates and soils refer to ASTM Sieve analyses and ASTM Tests.

.2 Other materials are specified with reference to CGSB Standards, CSA Standards, ASTM Standards and ASCII Standards.

1.2 SUBMITTALS

.1 Five (5) days after award of Contact the Contractor shall submit to the Engineer for review, a complete and detailed outline of the procedures and methods that he will employ for this section of the work.

.2 The Contractor shall not being work until the Engineer has reviewed the submittal.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to the site and store in a manner such that granular materials are kept in separate piles and manufactured materials are stored according to the recommendations of the Manufacturer.

.2 Sand and gravel material required shall be selected from available local sources. These sources shall be subject to the Engineer's approval and Land Use Permits must be obtained by the Contractor for the use of said materials.

.3 The Contractor is advised that screening of the material, especially for the fine gravel and sand, may be required to meet the specifications. The Contractor shall at no additional cost to the Owner screen and blend materials from one or more sources to achieve the gradations shown and to permit compaction to the required levels called for in this Section.

.4 The Owner reserves the right to have sampling of granular material and concrete as well as compaction tests carried out by an independent material testing firm to satisfy himself the specifications are met. Should results indicate that the specifications are not met, tall costs related the sample, testing and correction of the problem will be charged to the Contractor unless the Contractor can produce proof of compliance.

.5 Frozen material and ice will not be accepted as backfill material.

1.4 JOB CONDITIONS AND REGULATIONS

.1 Perform work under observation of the Safety Act and General Safety Regulations of the Territory of Nunavut.

.2 Perform work in a manner that will cause the least disruption to traffic.

.3 The Contractor is responsible for posting of warning and traffic signs; supply and placing of barricades and protective hoarding.

1.5 QUALITY ASSURANCE

.1 Submit to the Engineer a list of sources of materials including sand, gravel and borrow materials.

.2 Provide samples, test results, sieve analyses and reports for preliminary approval of materials.

1.6 DISPOSAL

.1 All materials on site whether stockpiled, stored or excavated are the property of the Owner, and the Owner reserves the right to keep any part or all of the material.

.2 The Contractor shall dispose of debris, waste, unsuitable material, rock or excess material in accordance with the specifications.

.3 The Contractor is encouraged to reuse materials encountered on site to the extent they comply with the specifications in this Section.

.4 Disposal sites will be designated by the Engineer.

.5 The Contractor shall dispose of all materials at sites to be located by the Contractor.

Part 2 Products

2.1 GRANULAR MATERIALS

.1 Fine Gravel: refer to Section 31 23 33 – Excavating, Trenching and Backfilling.

.2 Coarse Gravel: refer to Section 31 23 33 – Excavating, Trenching and Backfilling.

2.2 COMMON FILL

.1 Shall be native material found on the site or imported, and free of stones larger than 100 mm in size, of frozen matter, of rubbish and organics or vegetation.

2.3 RIP RAP

.1 Rip Rap: refer to Section 31 23 33 – Excavating, Trenching and Backfilling, as well as Section 32 11 10- Aggregates.

Part 3 Execution

3.1 CONSTRUCTION METHODS

.1 General:

.1 The Contractor is advised that the drawings and specifications are not based on a legal survey of the existing facilities or detailed survey information of existing site conditions.

.2 The Contractor is responsible to maintain and safeguard benchmarks and property throughout the construction period.

.3 Should a bench mark have to be relocated for the purpose of construction, it shall be relocated on a permanent structure and properly identified.

.4 The elevations and dimensions are shown on the drawings are for the purpose of construction, measurement and evaluating progress payments. The Contractor shall ensure that final elevations are adhered to.

.5 The Owner reserves the right to carry out independent testing of backfill materials and concrete as indicated above.

.2 Placing and Compaction of Backfill Material:

.1 Backfill material shall be in accordance with the specifications outlined in Item 2.1 above.

.2 Refer to Section 31 23 33 – Excavating, Trenching and Backfilling for placing and compaction requirements.

.3 Compaction equipment shall consist of a vibratory roller with an operating weight of not less than 1000 kg, or other equipment of similar capacity acceptable to the Engineer. Light hand operated compactors, such as Jumping jacks, and tracked equipment will not be considered adequate for compaction of tank foundations. The Contractor shall control the moisture level in the backfill material so as to achieve the required compaction levels.

3.2 CLEAN-UP

.1 The Contractor shall clean-up and dispose of all excess material, boulders and other debris as the work progresses.

.2 Before the work is considered complete, the Contractor shall remove all construction equipment, appliances, barricades, surplus materials, etc., and do such other work as may be necessary to leave the site or any other premises occupied by him in a neat, workmanlike condition, as required by the Engineer.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 31 23 13 Rough Grading
.2 Section 31 32 21 Geotextiles
.3 Section 31 37 00 RipRap
.4 Section 32 11 10 Aggregates - General
.5 Section 32 25 00 Roadways
.6 Section 33 11 16 Water Mains
.7 Section 33 36 50 Service Connections
.8 Section 33 42 12 Pipe Culverts

1.2 REFERENCES

.1 ASTM International

.1 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft;) (600kN-m/m;).

1.3 WORK INCLUDED

.1 The work covered by this section shall include excavation, trenching, backfilling, and disposal of excess materials, as required to complete the work covered elsewhere in the contract documents.

.2 The Contractor shall provide all labour, equipment, and materials to complete the works covered by this section.

1.4 MEASUREMENT AND PAYMENT

.1 Excavation and Subexcavation

.1 Excavation and Subexcavation will be measured in cubic metres. The quantity shall be determined by the Engineer through sections taken in the field.

.2 Where earth excavation is a separate item it shall be paid by the cubic metre. If earth excavation is considered as a part of an item, all costs associated with excavation will be included in that item. Any excavation required because of actions of the Contractor will be at his own expense.

.3 Where subexcavation is required because of soil or site conditions, and ordered by the Engineer, it will be paid for by the cubic metre. Subexcavation required because of the actions of the Contractor will be at his own expense. Subexcavation will include the supply, placing, and compaction of any extra granular material.

.2 Rock Excavation

.1 Rock excavation shall be measured by the cubic metre. The quantity shall be calculated using the in-field depths from the top of the pipe. The width shall be determined by utilizing the theoretical trench width in accordance with the detailed drawing herein.

.2 Section shall be taken by the Engineer at a minimum of 3 metre intervals or at major changes in rock elevation.

.3 Rock excavation shall be paid by cubic metre as measured by the Engineer at the unit price tendered by the Contractor.

.4 Rock excavation shall be considered separate from the cost of pipe installation.

.3 Granular Material

.1 Granular material will be measured by the cubic metre using previously measured truck boxes. All trucks are to be full and level at time of delivery. All truck loads will be signed for by the Engineer's agent before dumping.

.2 Granular material required under a specific item will be paid for under that item. Granular material ordered by the Engineer and not included under a tender item will be paid for per cubic metre. Granular material ordered by the Engineer because of actions of the Contractor will be at the Contractor's expense. The cost of granular material will include supply, placing. and compacting.

.4 Unsuitable Material

.1 Unsuitable material will be measured by the cubic meter based on the quantity of backfill material imported to replace the unsuitable material.

.2 Where unsuitable material is removed from the site in excess to the quantity which can be considered surplus, i.e. material is required to be imported to replace it. Payment for disposal of the unsuitable material shall be incidental to the importing of the backfill material

.5 Backfill

.1 Where backfill is considered as a part of the item, all costs associated with backfill will be included in that item. If backfilling is required as a result of the actions of a Contractor it will be at his own expense.

.6 Pipe and Culvert Bedding

.1 All costs associated with the bedding shall be included in the cost of pipe installation.

1.5 CLASSIFICATION OF MATERIAL

.1 Earth Excavation

.1 includes the excavation of all materials except rock excavation classified hereinafter.

.2 Rock Excavation

.1 includes the excavation of all boulders more than 0.75 cubic metres in volume, or solid ledge rock or concrete foundations which, in the opinion of the Engineer, requires for its removal drilling and blasting or wedging or sledging or barring. No soft or disintegrated rock which can be removed with a pick, or loose, shaken or previously blasted rock will be measured or allowed. Frozen materials shall not be classified as rock nor will extra payment be allowed for excavating same.

.3 Backfill

.1 in areas other than existing roadways, machine backfilling using approved excavated material will be permitted from the top of the granular backfill.

.4 Surplus Material

.1 excavated material which is not required for the completion of the work.

.5 Suitable Backfill Material

.1 material from excavation which, in the opinion of the Engineer, is suitable for use as backfill or for other processes.

.6 Unsuitable Material

.1 material from an excavation which in the option of the Engineer is not suitable for use as backfill or other processes.

1.6 OCCUPATIONAL HEALTH AND SAFETY ACT

.1 All excavations will have to conform strictly to the requirements of the latest Occupational Health and Safety Act adopted by Nunavut.

1.7 SAFETY MEASURES

.1 Suitable warning signs, lights and barricades shall be erected for the protection of vehicles and pedestrians during construction. Watchmen or flagmen, when required, shall be supplied by the Contractor at his own expense.

.2 The Contractor shall comply with the instructions of a safety inspector appointed or recognized by Nunavut whose duty is to enforce territorial acts governing the excavation of trenches and the protection of same.

.3 The Contractor shall inform the municipality's safety inspector of his intention to excavate at least 24 hours before commencing work.

1.8 CAUTION IN EXCAVATION

.1 The Contractor must exercise proper caution in excavating and must repair and make good at his own expense any and all damage done to underground services, culverts, pipes, sewers, house sewers, etc. Where necessary, the Contractor shall make necessary explorations to discover location of existing pipes, conduits, services, etc.

1.9 BLASTING

.1 Retain licensed explosives expert to program and supervise blasting work, and to determine precautions, preparation and operations techniques.

.2 Submit documentation to the Engineer verifying explosives expert's qualifications in accordance to Federal and Territorial laws and Municipal ordinances.

1.10 INCONVENIENCE TO ADJACENT PROPERTY OWNERS

.1 Construction of the work shall be carried out in such a manner that a minimum of inconvenience is caused to the owners and occupants of property adjacent to the works.

1.11 WORKING RESTRICTIONS

.1 The Contractor shall be responsible for maintaining adequate surface drainage during construction. He shall provide all necessary measures to ensure that natural drainage is not impeded to the detriment of the local municipal authority, private landowners, or the public. Water pumped out or removed from a trench shall not be discharged in the existing sewers unless permission in writing has been obtained from the authority having jurisdiction.

Part 2 Products

2.1 MATERIALS

.1 Granular Material

.1 Granulars Type1,2,3,5,and Modified type 5 pipe bedding, Riprap and Sand shall meet the requirements set out in Section 32 11 10: Aggregates - General.

.2 Granular Backfill

.1 Backfill material shall be selected from materials taken from the excavation, if in the opinion of the Engineer, they are suitable.

Part 3 Execution

3.1 PREPARATION OF WORK

.1 The Contractor, at his own expense, shall clear the surface or road as may be necessary for the full width and length of the proposed trenches or structures and shall dispose of all refuse in a manner satisfactory to the Engineer. The unit prices for the work shall include all costs incurred in removing material of whatever nature from the surface of the ground or road.

3.2 ALIGNMENT AND GRADE

.1 Trenches shall be dug to the alignment and grade required and only so far in advance of pipe laying as the Engineer shall permit.

.2 The bottom of the pipe trench shall be excavated to a flat surface for the bedding material. Earth, boulders and rock shall be removed or excavated to provide a clearance of at least 150 mm below the pipe and the excavation for bedding of the pipe shall be refilled with thoroughly compacted material as specified herein.

3.3 DRAINAGE

.1 The Contractor shall keep all portions of the work properly and efficiently drained during construction and until completion. He shall be held responsible for all damage that may be

caused as the result of water backing up or flowing over, through, from, or along any part of the work or surrounding properties due to his operation.

.2 All costs associated with providing drainage for the work as required, shall be included in the unit prices for the installation of mains and access vaults.

3.4 EXCAVATION AND PREPARATION OF TRENCH

.1 Excavation shall be taken to mean the removal from the trench of all materials of whatever kind encountered, for the laying or construction therein of all pressure mains, sewer mains, access vaults and appurtenances. All excavation shall be made exactly to line and grade, as shown on the drawings or as established by the Engineer. The length of trench which has not been backfilled shall not extend beyond one access vault to the rear of the working area. Excavation, pipelaying, and backfilling shall proceed at such a pace as to prevent permafrost degradation. It shall be braced and drained in a manner to insure that workers may work safely and efficiently therein.

.2 The trench shall be excavated to the depth shown on the drawings so as to provide a firm foundation for the pipe sand bedding on solid and undisturbed ground. Any part of the bottom of the trench excavated below the specified grade shall be corrected with approved backfill, thoroughly compacted as directed by the Engineer, with no extra cost to the Owner. The finished subgrade shall be prepared accurately.

.3 Large rocks and boulders shall be removed to provide a clearance of at least 0.15 metres below and on each side of all insulation, pipe, access vaults and appurtenances. This is the minimum clear distance which will be permitted between any part of the pipe and appurtenances being laid and any part, projection or point of such rocks, boulders or stones, the subgrade shall be made by backfilling with an approved sand or gravel in 0.15 metres below and on each side of all insulation, pipe, access vault and appurtenances. This is the minimum clear distance which will be permitted between any part of the pipe and appurtenances being laid and any part, projection or point of such rocks, boulders or stones, the subgrade shall be made by backfilling with an approved sand or gravel in 0.15 metre layers.

.4 These layers shall be thoroughly tamped as directed by the Engineer so as to provide a uniform and continuous bearing and support for the pipe bedding.

.5 Where the bottom of the trench at subgrade is found to be unstable due to the presence of ice rich soil, ashes, cinders, all types of refuse, vegetable or other organic material, or large pieces of fragments of inorganic material which, in the judgement of the Engineer, should be removed or where filling to pipe grade is required, the Contractor shall excavate and remove such unsuitable material to the depth ordered by the Engineer. Before the pipe bedding is laid, the subgrade shall be made by backfilling with approved gravel which shall be thoroughly tamped to grade in 0.15 metre layers. The finished subgrade shall be prepared accurately by means of hand tools.

.6 Ice rich soils shall be removed completely or to a maximum depth of 0.45 metres measured below the insulation of pipe lines.

.7 The cost of such additional excavation of unstable subgrade due to the presence of unsuitable materials, and backfill, ordered by the Engineer shall be paid for at the Tendered unit price.

.8 The Contractor shall obtain the Engineer's approval, in writing, of the trench or excavation preparation prior to placing pipe bedding, backfill, or structures in the trench or excavation.

.9 **NO EXTRA PAYMENT HOWEVER SHALL BE MADE** for additional excavation and backfill that has become necessary due to subgrade that has become unstable due to water from melting snow and ice that has entered the trench. The trench must be kept dry; see Clause 3.13 "Water In Excavation".

3.5 ROCK EXCAVATION

.1 Any boulders greater than 0.75 cubic metres in volume and any rock that cannot be excavated with a 0.5 cubic metre or larger trackmounted machine, or rock that requires blasting for its removal, will be paid for as rock. Volume of individual boulders will be determined by measuring three mutually perpendicular dimensions. When rock is encountered, the Engineer must be notified at once, so that measurements can be made.

.2 Measurements for rock volume shall be taken from the top of the rock strata to the bottom of the strata. If the rock strata extends below the elevation of the invert of the pipe or culvert, then an allowance of 0.15 metres below the bottom of the pipe insulation or culvert will be used in calculating the volume of rock.

.3 Soft shale, soft sandstone, or other rock that can, in the opinion of the Engineer, be successfully excavated with a 0.5 cubic metre backhoe or equivalent without blasting and without unusual wear and tear to the machine will not be classified as "rock excavation". Hardpan will not be classified as "rock excavation". Frozen subgrade material or permafrost will not be classified as "rock excavation".

3.6 BLASTING

.1 Use pre-shearing, cushion blasting or other smooth wall drilling and blasting techniques. The Contractor's methods or procedure in blasting shall conform to Federal and Territorial laws and Municipal ordinances.

.2 Blasting for excavation will be permitted only after securing the approval of the local municipal authority and only when proper precautions have been taken for the protection of persons or property. The hours of blasting may be fixed by the local municipal authority. Any damage caused by blasting shall be repaired by the Contractor at his own expense. The Contractor will be responsible for obtaining permits required for blasting operations.

3.7 BRACING AND SHORING

.1 Bracing and shoring is the sole responsibility of the Contractor. Open-cut trenches shall be sheeted and braced as required by the Workers' Compensation Board and Municipal ordinances, and as may be necessary to protect life, property, and work.

.2 When close sheeting is required, it shall be so driven as to prevent adjacent soil from entering the trench either below or through such sheeting. The Engineer reserves the right to order the sheeting driven to the full depth of the trench or to such additional depths as may be required for the protection of the work. Where the soil in the lower limits of the trench has the necessary stability, the Engineer, at his discretion, may permit the

Contractor to stop the driving of sheeting at some designated elevation above the trench bottom. The granting of permission by the Engineer, however, shall not relieve the Contractor in any degree from his full responsibility under the contract. Sheeting and bracing, which have been ordered left in place, must be cut off and removed for a depth of one metre below the established road grade or the existing surface of the road, whichever is lower. Trench bracing, except that which must be left in place may be removed as the backfilling proceeds. Backfilling and withdrawal of sheeting shall proceed together; no voids shall be left in the trench by the withdrawal of the sheeting. Sheeting shall not be driven any further below the bottom of the trench than is necessary to insure proper support for the sheeting.

.3 The cost of furnishing, placing and removing the sheeting and bracing shall be included in the price bid for the work. When sheeting and bracing have been ordered left in place by the Engineer, the payment for such material shall be as an extra at cost of the material, plus 20% and shall include the upper one metre of "cut-off" section of the sheeting

3.8 TRENCHING BY HAND

.1 In any location where the use of trench digging machinery might cause property or utility damage the Contractor shall carry out the trenching by hand at no extra cost to the Owner.

3.9 EXCAVATED MATERIAL

.1 All excavated material shall be piled into three piles –

.1 Suitable material that can be used for backfill

.2 Unsuitable material that can not be used for backfill or other processes, and

.3 Frozen Material. If upon inspection by the Engineer, the thawed material is deemed suitable for use as backfill, this material can be classified as suitable, otherwise the material will be classified as unsuitable.

.2 Excavated material not required for the completion of the work shall be considered surplus material, and disposed of according to Clause 3.12, “Cleaning Up and Disposal of Surplus Excavated Material”.

.3 Unsuitable material shall be considered surplus material.

.4 All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing roadways and driveways. Hydrants under pressure, access vaults and other utility controls shall be left unobstructed and accessible. Gutters and swales shall be kept clear or other satisfactory provisions made for roadway drainage, and natural watercourses shall not be obstructed.

.5 The earth taken from the trench shall be neatly deposited at the sides in such a manner as to obstruct the road or driveway as little as possible. When it is impractical, in the opinion of the Engineer, to place the earth at the side of the trench it shall be removed and deposited as designated by the Engineer. In either case, a clear space must be left on one side of the trench to accommodate the survey stakes.

.6 Permafrost excavated from the trench shall not be stockpiled on top of material to be used as backfill. Materials which are unsatisfactory after permafrost has been stockpiled on top of it shall be considered contaminated and removed from the site by the Contractor. The

Contractor shall be governed by Clause 3.11, "Ownership of Excavated Materials", and Clause 3.12, "Cleaning Up and Disposal of Surplus Excavated Material", when disposing of the contaminated material.

.7 Extra backfill material required because of the disposal of material contaminated by perma frost shall be supplied, placed, and compacted by the Contractor at his expense; see Clause 3.14 "Backfilling", for specifications on the approved backfill materials and methods

3.10 OWNERSHIP OF EXCAVATED MATERIAL

.1 Surplus earth and other excavated materials will remain the property of the Owner.

.2 All surplus or other material of any kind arising from, or during the construction of the works or any portion, thereof which belongs to the Owner shall not be sold, thrown away, dumped, wasted or otherwise disposed of, except as directed by the Engineer. If so disposed of by the Contractor, the Engineer shall ascertain, as nearly as he can, the quantity and value thereof, and shall direct the Contractor or his sureties to pay unto the Owner the amount thus found, or the Owner may deduct it from any subsequent progress estimate.

3.11 CLEANING UP AND DISPOSAL OF SURPLUS EXCAVATED MATERIAL

.1 All surplus and excess materials that arise out of the construction of the works shall be removed therefrom and neatly piled, evenly spread or deposited where and as directed by the Engineer, **and the whole expense of loading, hauling, unloading, piling, spreading or otherwise dealing with the said waste material shall be borne by the Contractor.** If any material is dropped or spilled it shall be promptly removed to the satisfaction of the Engineer.

3.12 WATER IN EXCAVATION

.1 All water pumped or drained from the work shall be disposed of in a suitable manner satisfactory to the Engineer, without damage to the Construction work of other property, structures, or persons.

.2 The expense of removing the water, regardless of origin, is the responsibility of the Contractor. The Contractor shall be wholly responsible for any damage that may occur due to ground water or storm water entering the trench during the period of construction.

.3 No extra payment shall be made for additional excavation and backfill that is required due to subgrade that has become unstable due to water from any source.

3.13 BACKFILLLING

.1 Trench excavations shall be backfilled with materials taken from the excavations, if in the opinion of the Engineer, they are suitable for use as compacted backfill. Otherwise Type 1 material" or backfill approved by the Engineer shall be supplied by the Contractor as backfill.

.2 All backfill shall be mechanically compacted in even layers not exceeding 0.15 metres in thickness so that there is no subsequent subsidence in the trench. The backfill shall be

compacted to a density of 95% of the maximum density at optimum moisture content as determined by the Standard Proctor Test as per ASTM D698-12e2.

.3 Any deficiency in the quantity of material for backfilling the trenches or filling depressions caused by settlement shall be supplied by the Contractor at his expense.

.4 Trenches shall be backfilled to the original ground line level. The remaining fill shall be classified as surplus excavated material and disposed as per Clause 3.12 "Cleaning Up and Disposal of Surplus Excavated Material".

.5 No frozen material will be accepted as backfill. Surfaces that have settled as a result of using frozen backfill will be regraded at the Contractor's expense.

3.14 RESTORATION OF SURFACES AND/OR STRUCTURES

.1 Except where otherwise specified, the Contractor shall restore granular road surfaces, pavement, ditches, fences, or other disturbed surfaces or structures to a condition equal to that before the work began and to the satisfaction of the Engineer, and shall furnish all labour and materials incidental thereto at his own expense.

.2 In open field areas upon completion of all trenching and backfill, the entire disturbed area shall be bladed level.

3.15 PIPE AND CULVERT BEDDING

.1 Bedding materials shall be supplied, placed, spread, and compacted as specified elsewhere in these specifications.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS Section 31 23 10 - Excavating, Trenching and Backfilling.

1.2 REFERENCES American Society for Testing and Materials International (ASTM):

.1 ASTM D4491-17, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

.2 ASTM D4595-11, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.

.3 ASTM D4716-14, Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.

.4 ASTM D4751-16, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-4.2 No. 11.2-M89 (R2013), Textile Test Methods - Bursting Strength - Ball Burst Test (Extension of September 1989).

.2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes.

.1 No.2-M85, Methods of Testing Geosynthetics - Mass per Unit Area.

.2 No.3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles.

.3 No.6.1-93, Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles Under No Compressive Load.

.4 No.7.3-92, Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.

.5 No. 10-94, Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size.

.3 Canadian Standards Association (CSA International):

.1 CAN/CSA G40.20-04/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 SUBMITTALS

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

.2 Submit to the Engineer following samples at least four (4) weeks prior to beginning work.

.1 Minimum length of 2 m of roll width of geotextile.

.2 Minimum of 1 m seam with at least 300 mm of geotextile on both sides of seam.

.3 Submit to the Engineer copies of mill test data and certificate at least four (4) weeks prior to start of work, and in accordance with Section 01 33 00 - Submittal Procedures.

.4 Submit to the Engineer, upon request, the manufacturer=s recommended procedures for installation and instructions for handling of the selected geotextile.

1.4 DELIVERY, STORAGE AND HANDLING

.1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

.2 Handling of the selected geotextile to be as per manufacturer=s recommendations.

Part 2 Products

2.1 MATERIAL

.1 Woven geotextile for sediment control fence shall be a sheet of woven plastic yarn.

.1 Composed of: minimum 85% by mass of polypropylene, polyethylene, polyamide, polyester or polyvinylidene chloride with stabilizers or inhibitors added to the base plastic to make the filaments resistant to deterioration by ultra-violet and heat exposure.

.1 Physical properties (MARV):

Physical Property	Min. Requirement
Tearing Strength (ASTM D4533-15)	200 N
Grab Tensile Strength (ASTM D4632-15a)	400 N
Elongation at Break (ASTM D4632-15a)	25%
Apparent Opening Size (ASTM D4751-16)	840 μm max.
UV Degradation (ASTM D4355-15)	70% Ret. min.
Permittivity (ASTM D4491-17)	0.01 sec^{-1} min.

.2 Seam strength: Sewn in accordance with manufacturer=s recommendations, or lapped a minimum of 600 mm.

.3 Thread for sewn seams shall be equal or better resistance to chemical and biological degradation than geotextile.

.4 Sediment control fence may be prefabricated or constructed on site from the specified individual components.

.5 Non-woven geotextile for Structural Fill Pad and Drainage Swales:

.1 Physical properties (MARV):

Physical Property	Min. Requirement
Tearing Strength (Trapezoid Method)	250 N
Grab Tensile Strength (Both Directions)	600 N
Elongation at Break	50%
Apparent Opening Size	50 to 250 µm
UV Degradation	----
Permittivity	1.25 to 2.75 sec^{-1}

Part 3 Execution

3.1 INSTALLATION

.1 Sediment Control Fence:

.1 Sediment control fence shall be installed as indicated on the drawings and prefabricated sediment control fence shall be installed as per the manufacturer=s instructions.

.1 In areas of potential sheet flow runoff where construction activity may cause the drainage run-off to transport sediment(s), and the Contract Documents do not provide for sediment control fences in these areas, the Contractor shall ensure that sediment control fences are properly located for effective runoff control.

.2 The Contractor shall maintain the sediment control fence in a functional condition continuously from the time of installation until the completion of the Contract or removal.

.3 The Contractor shall inspect all sediment control fences after each rainfall and at least daily during periods of prolonged rainfall.

.4 The Contractor shall immediately repair any damage to sediment control fences or parts thereof.

.5 The Contractor shall remove retained sediment prior to it having accumulated to a level approximately but not exceeding one-half the height of the fence, and this sediment shall be disposed of at a location at least 30 m away from any watercourse, and in such a manner that the sediment will not be returned to the work area or the watercourse; or

.1 Subject to the approval of the Engineer, the Contractor may install a second backup sediment control fence, at his/her own expense.

.6 The Contractor shall remove all sediment control fence and the time of such removal shall be subject to the Engineer=s approval but in all cases shall occur prior to the completion of the Contract.

.1 Sediment control fence removed shall become the property of the Contractor and shall be disposed of outside the work site.

.2 If the Engineer notifies the Contractor in writing, prior to the completion of the Contract, that all or any part of the sediment control fence is to remain in place, the Contractor shall be deemed to have completed his/her obligations for that portion of the sediment control fence under this Item and the sediment control fence shall become the property of the Owner.

.7 At the time of removal, the Contractor shall excavate any remaining sediment and dispose of it at a location at least 30 m from any watercourse, and in such a manner that the sediment will not be returned to the work area or the watercourse and shall dress and seed the area of the removed fence and sedimentation, to the satisfaction of the Engineer.

.1 Over Slope of Type I Structural Fill Pad and Drainage Swale:

.1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position.

.2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.

.3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

.4 Overlap each successive strip of geotextile 600 mm over previously laid strip.

.5 Join successive strips of geotextile by sewing or overlapping.

.6 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.

.7 After installation, cover with overlying layer within four (4) hours of placement.

.8 Replace damaged or deteriorated geotextile to approval of the Engineer.

.9 Place and compact soil layers in accordance with Section 31 23 10 – Excavating, Trenching and Backfilling.

.10 Extend fabric 300 mm beyond toe of slope of Structural Fill Pad.

3.2 PROTECTION

.1 Vehicular traffic is not permitted directly on geotextile.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 The work covered by this section includes the placement of rip-rap stone as required elsewhere or as required

1.2 RELATED REQUIREMENTS

.1 Section 31 32 21 Geotextiles
.2 Section 32 11 10 Aggregates - General
.3 Section 32 25 00 Roadways
.4 Section 33 42 12 Pipe Culverts

1.3 MEASUREMENT AND PAYMENT

.1 Rip-rap used for works covered in other sections will be measured and payments made under clauses specified in corresponding sections.

Part 2 Products

2.1 STONE

.1 Rip-rap stone to meet the requirements as set out in Section 32 11 10: Aggregates - General.

Part 3 Execution

3.1 PLACING

.1 Where rip-rap is to be placed on slopes, excavate trench at toe of slope to dimensions as indicated.

.2 Fine grade area to be rip-rapped to uniform, even surface. Fill depressions with suitable material and compact to provide firm bed.

.3 Place rip-rap to thickness and details as indicated.

.4 Place stones in manner approved by Engineer to secure surface and create a stable mass. Place larger stones at bottom of slopes.

.5 Hand placing:

.1 Use larger stones for lower courses and as headers for subsequent courses.
.2 Stagger vertical joints and fill voids with rock spalls or cobbles.
.3 Finish surface even, free of large openings and neat in appearance.

.6 Where required, install a geotextile filter fabric on a firm compacted bed as recommended by the manufacturer. Place rip-rap in such a manner as to avoid damage to geotextile filter fabric.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 31 23 33 - Excavating, Trenching, and Backfilling

.2 Section 31 37 00 - Rip Rap

.3 Section 32 25 00 – Roadways

.4 Section 33 11 16 - Water Mains

.5 Section 33 36 50 - Service Connections

1.2 WORK INCLUDED

.1 The work covered by this section shall include the supply of all labour, material and equipment to generate aggregates material as specified, and stockpile materials for use by others as specified.

1.3 SOURCE APPROVAL

.1 Source of materials to be incorporated into work or stockpiled requires approval.

.2 Inform Engineer of proposed source of aggregates, provide, and ship sampling for testing 2 weeks prior to commencing production.

.3 Locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements; materials from the proposed source do not meet, or cannot reasonably be processed to meet specified requirements in the opinion of the Engineer.

.4 Should a change of material source be proposed during work, advise Engineer immediately, provide and ship samples for testing.

.5 Acceptance of a material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

1.4 PRODUCTION SAMPLING

.1 Aggregate will be subject to continual sampling by Engineer during production.

.2 Provide Engineer with ready access to source and processed material for purpose of sampling and testing.

.3 Bear the cost of sampling and testing of aggregates which fail to meet specified requirements:

1.5 MEASUREMENT AND PAYMENT

.1 Granular material used for works covered in other sections will be measured and payments made under clauses specified in corresponding sections.

1.6 REFERENCES

.1 ASTM International

.1 ASTM C117-13, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C131-14, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.3 ASTM C136-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft;) (600kN-m/m;).

.5 ASTM D1557-12, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft;) (2,700kN-m/m;).

.6 ASTM D1883-16, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

.7 ASTM D4318-10, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

Part 2 Products

2.1 MATERIALS

.1 Aggregate quality

.1 sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material or other deleterious substances.

.2 Flat and elongated particles are those whose greatest dimension exceeds five times their least dimension.

.3 Fine aggregates satisfying requirements of applicable section shall be one, or a blend of following:

.1 Manufactured sand.

.2 Screenings produced in crushing of quarried rock, boulders, gravel, or slag.

.4 Coarse aggregates satisfying requirements of applicable section shall be one of or blend of following:

.1 Crushed rock or slag.

.2 Gravel composed of naturally formed particles of stone.

2.2 TYPE 5

.1 Crushed stone or gravel consisting of hard, durable, angular particles free from clay lumps, cementation, organic material, frozen material, and other deleterious materials.

.2 Gradations to be within limits specified when tested to ASTM C136-06 and ASTM C117-04 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart.

Sieve Designation	% Passing
26.5 mm	100
19.0 mm	85-100
13.2 mm	65-90
9.5 mm	50-73
4.75 mm	35-55
1.18 mm	15-40
0.300 mm	5-22
0.075 mm	2-8

.3 Other properties as follows:

.1	Minimum Percent Crushed	60
.2	Plasticity Index ASTM D4318-10 Maximum	0
.3	Los Angeles Abrasion ASTM C131-06 Gradation "A" Maximum % loss by weight:	60

2.3 TYPE 2

.1 Crushed pit run or screen stone, gravel consisting of durable angular particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.2 Gradations to be within limits specified when tested to ASTM C136-06 and ASTM C117-04 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart.

Type 2 Fill (75 mm Minus Screened Gravel):

Sieve Designation	% Passing
75 mm	100
40 mm	60-80
20 mm	40-66
10 mm	25-54
4.75 mm	15-43
2.36 mm	10-35
0.600 mm	5.23
0.150 mm	3-12
0.075 mm	2-10

.3 Other properties as follows:

.1 Plasticity Index
ASTM D4318-10
Maximum 0

.2 Los Angeles Abrasion
ASTM C131-06
Maximum % loss by weight 50

2.4 TYPE 1

.1 Crushed stone or gravel consisting of hard, durable, angular particles free from clay lumps, cementation, organic material, frozen material, and other deleterious materials.

.2 Gradations to be within limits specified when tested to ASTM C136-06 and ASTM C117-04 and to have a smooth curve without sharp breaks when plotted on semi-log grading chart.

.1 Type 1 Structural Fill: Import crushed, pit run or screened stone, gravel or sand consisting of hard durable particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials. Gradations to be within limits specified when tested to ASTM C 136-96a and ASTM C 117-95. Sieve sizes to CAN/CGSB-8.1-88.

Sieve Designation	% Passing
90 mm	100
75 mm	95-100
50 mm	73-95
37.5 mm	58-87
25 mm	
19 mm	35-69-
9.5 mm	25-54
4.75 mm	17-43
2.00 mm	12-35
0.3 mm	4-16
0.075 mm	0-9

Part 3 Execution

3.1 PROCESSING

.1 Process aggregate uniformly using methods that prevent contamination, segregation, and degradation.

.2 Blend aggregates, if required, to obtain gradation requirements, as specified. Use approved methods and equipment.

.3 Blending to increase percentage of crushed particles or decrease percentage of flat and elongated particles is permitted.

.4 Wash aggregates, if required to meet specifications. Use only equipment approved by Engineer.

3.2 HANDLING

.1 Handle and transport aggregates to avoid segregation, contamination, and degradation.

3.3 STOCKPILING

.1 Stockpile aggregates on site in locations as indicated or as designated. Do not stockpile on completed pavement surfaces where damage to pavement may result.

.2 Stockpiling sites shall be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

.3 Except where stockpiled on acceptably stabilized areas, provide compacted base not less than 300 mm in depth to prevent contamination of the aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into work.

.4 Separate different aggregates by substantial dividers or stockpile far enough apart to prevent intermixing.

.5 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Engineer within 24 h of rejection.

.6 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

.7 Coning of piles or spilling of material over edges of pile will not be permitted.

.8 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.4 AGGREGATE STOCKPILE CLEANUP

.1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.

.2 Leave any unused aggregates in neat compact stockpiles.

.3 On completion of the project, remove excess aggregates from site.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 31 23 33 - Excavating, Trenching and Backfilling
.2 Section 31 37 00 - Rip Rap
.3 Section 32 11 10 - Aggregates – General
.4 Section 32 25 00 – Roadways
.5 Section 33 11 16 - Water Mains
.6 Section 33 36 50 - Service Connections
.7 Section 33 42 12 - Pipe Culverts

1.2 GENERAL

.1 This specification shall be read in conjunction with the drawings and all other sections of the contract documents.

1.3 WORK INCLUDED

.1 The work under this section shall include the supply and placing of all equipment, labour and materials necessary to:

.1 Construct roadways including excavation to subgrade, subgrade preparation, supply, placement and compaction of granular type 1, type 2 and type 5, supply and placement .
.2 Construct ditches and drainage works.

1.4 MEASUREMENT AND PAYMENT

.1 Road reconstruction shall be paid in Installation of Piping as stated in Special Provisions – 01 12 50 under item 1.7.6.

1.5 REFERENCES

.1 ASTM International

.1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft;) (600kN-m/m;).

1.6 DEFINITIONS

.1 Surface Course

.1 The surface course shall be the top layer of material which will be exposed to vehicle traffic.

.2 Base Course:

.1 The base course shall be the layer of material directly below the top course.

.3 Subbase

.1 The subbase shall be the layer of material below the base course.

.4 Subgrade

.1 The subgrade shall be the material which the road structure is founded on. This may be the existing ground, the prepared base of an excavation, or the top of an embankment of engineered fill.

Part 2 Products

2.1 MATERIALS

.1 Type 1

.1 Type 1 shall conform to the requirements listed in Section 32 11 10: Aggregates - General.

.2 Type 2

.1 Type 2 shall conform to the requirements listed in Section 32 11 10: Aggregates - General.

.3 Type 3

.1 Type 3" shall conform to the requirements listed in Section 32 11 10: Aggregates - General.

.4 Type 5"

.1 Type 5" shall conform to the requirements listed in Section 32 11 10: Aggregates - General.

Part 3 Execution

3.1 STRIPPING ORGANIC MATERIAL

.1 Unless specifically directed, there shall be no stripping of the organic layer of material for road construction.

.2 Stripping of the organic material shall only occur in areas requiring excavation to prepare the subgrade at the design elevation.

3.2 EXCAVATION AND SUBGRADE PREPARATION

.1 This work shall include all excavation necessary to prepare the subgrade in areas requiring new construction or reconstruction and shall include all hauling, spreading and levelling of excavated material.

.2 The excavated material shall be hauled to the location as directed of the Engineer. It shall be spread, graded ad compacted as directed by the Engineer.

.3 The Contractor shall not excavate below the subgrade level unless directed by the Engineer.

.4 The bottom of the excavation shall provide a flat, uniform, dry surface for the construction of the subbase.

.5 Upon completion of the excavation to the subgrade elevation, the bottom of the excavation shall be inspected and approved by the Engineer prior to the placement of any material for the construction of the subbase.

.6 If the bottom of the excavation is unsuitable for the placement of granular material, the Contractor shall notify the Engineer.

3.3 SUBGRADE FILLING

.1 In all areas requiring subgrade fill, the Contractor shall be responsible to supply, haul, place and compact suitable material to the elevations as indicated on the drawings. No organic or other unsuitable materials will be acceptable. The material shall be placed to provide a width sufficient to allow for the driving surface specified, shoulders, side slope specified, base course and subbase. Material used to fill to subbase shall have a 2 horizontal to 1 vertical (2:1) side slope unless otherwise specified.

3.4 CONSTRUCTION OF ROADWAY GRANULAR COURSES

.1 The granular courses and surface materials shall be kept free from clay and other types of deleterious materials. The Contractor shall ensure that his operations do not disturb underlying work.

.2 The granular courses shall be placed without segregation in uniform layers such that the thickness of the compacted layer is not greater than specified below without written approval from the Engineer;

.1	Surface Course	100mm
.2	Base Course	200mm
.3	Subbase Course	300mm minimum

.3 Each layer shall be bladed to a smooth surface conforming to the required cross-section.

.4 Prior to closing down operations for each working day the granular material shall be bladed and compacted and, if necessary, covered with sufficient base material to carry traffic.

.5 In no case shall a layer of granular material be laid and compacted on frozen layer of granulars, as the top layer will not bind to the base. The Contractor shall be responsible for making good any section of road which the Engineer considers to be below standard because granular material was laid on a frozen granular surface. All costs associated with this work will be borne by the Contractor.

.6 The granular courses shall be maintained to the tolerances in grade and cross-section and to the specified density until the project is accepted.

.7 The Engineer may direct that soft or otherwise defective areas be cut out and backfilled with granular material. This work is to include the excavation, removal and disposal on-site of contaminated material, and the supply, placing and compacting of granular “A” material.

.8 Should, in the Engineer's opinion, the failure of granular course been caused by the Contractor's negligence, the full reinstatement shall be carried out and the Engineer's word shall be final and binding upon this matter.

3.5 SURFACE TOLERANCE

.1 The surface of the uppermost layer of granular material shall be bladed, shaped and compacted to produce the required surface contour.

.2 The finished granular courses shall not deviate more than 30 mm from the specified grade and cross-section and the surface shall not deviate more than 15 mm at any place on a 3 metre template.

.3 The finished granular courses shall not deviate more than the amount specified below from the specified grade and cross-section, shall not be consistently high or low, and the surface shall not deviate more than 15 mm at any place on a 3 metre template.

.1	Surface Course	+15mm to -15mm
.2	Base Course	+15mm to -25mm
.3	Subbase Material	+25mm to -40mm
.4	Subgrade	+25mm to -50mm

3.6 COMPACTION

.1 The maximum rate of placing material shall be as specified or as instructed by the Engineer. The maximum rate will be determined by the adequacy of the compaction obtained.

.2 Each layer of material shall be compacted to 95% Standard Proctor Dry Density (per ASTM D698-12) unless otherwise specified before the next layer is placed.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 31 23 33 - Excavating, Trenching and Backfilling
.2 Section 32 11 10 - Aggregates - General
.3 Section 32 25 00 - Roadway
.4 Section 33 36 50 - Service Connections

1.2 REFERENCES

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA B300-99, Hypochlorites.
.2 ANSI/AWWA B301-10, Liquid Chlorine.
.3 ANSI/AWWA B303-13, Sodium Chlorite.
.4 ANSI/AWWA C500-09, Metal-Seated Gate Valves for Water Supply Service (Includes Addendum C500a-95).
.5 ANSI/AWWA C504-10, Rubber-Seated Butterfly Valves.
.6 ANSI/AWWA C651-14, Disinfecting Water Mains.
.7 ANSI/AWWA C800-01, Underground Service Line Valves and Fittings (Also Included: Collected Standards for Service Line Materials).

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft;) (600kN-m/m;).
.2 ASTM F714-12e2, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

.3 American Water Works Association (AWWA)/Manual of Practice

.1 AWWA M17-2006, Installation, Field Testing, and Maintenance of Fire Hydrants.

.4 Canadian General Standards Board (CGSB)

.1 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.

.5 Canadian Standards Association (CSA International)

.1 CSA B137 Series-02, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
.1 CSA B137.1-09, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.

.6 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.7 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA)

.8 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S520-07, Hydrants.

.2 CAN4-S543-09-AM1, Internal-Lug, Quick Connect Couplings for Fire Hose.

1.3 WORK INCLUDED

.1 The work to be done under this contract consists of furnishing all equipment, materials and labour necessary for the installation of water mains in accordance with the terms of this contract.

.2 Specifically, the work shall include:

.1 The installation of the water mains as specified in this section or shown on the contract drawings, including any connections to access vaults or existing water mains.

.2 Carry out a pressure and leakage test on all new works.

.3 Chlorination and commissioning of the new water mains.

.4 Excavation, backfilling, consolidation and restoration of surfaces

1.4 MEASUREMENT AND PAYMENT

.1 The measurement of completed work shall be by the linear metre, from flange to flange as measured by the Engineer. All quantities measured by the Engineer shall be final.

.2 Payment shall be per linear metre of water main as measured.

.3 If the water main is to be installed in a common trench with the sanitary sewer, the cost of works associated with both the water main and the sanitary sewer will be split evenly between the two items.

1.5 RECIRCULATION LINE

All references to water mains within these specifications shall also apply to the installation of recirculation lines.

Part 2 Products

2.1 MATERIALS

.1 Polyethylene Pipe

.1 All Polyethylene pipe shall be Series 128 (883 kPa) high density polyethylene (HDPE) pipe with 75 mm urethane insulation encased in a 1.14 mm polyethylene black jacket conforming to CGSB 41-GP-25M77.

.2 Where specified on the drawing for the water main to be metal jacketed, the above described pipe will be wrapped in 26 gauge galvanized steel jacket outside the polyethylene jacket.

.3 All polyethylene pipe, fittings, stubends, etc., shall be of the same manufacturer's series, wall thickness and the same grade of polyethylene. All gaskets will have the same internal diameters as the series pipe and all bolts and back up rings will be compatible to allow tightening without washers. Standard of acceptance shall be KWH Sclairpipe, Urecon UIP, or approved equal.

.4 No joints shall be allowed in piping covered with shop applied insulation.

.5 All jacketed pipe shall have a permanent factory applied marking indicating manufacturer, size, series, and project identification at not greater than one metre intervals along its length, i.e. "Dupont 200 mm Series 128".

.6 Urethane Insulation

.1 Insulation for pipe lines, fittings, etc., shall be rigid closed cell polyurethane insulation to the thickness shown on the drawings. No joints shall be allowed in piping covered with shop applied insulation. Properties of all urethane insulation shall be:

Density (kg per cubic metres core) ASTM D-1622-08	35
Compressive Strengths kPa @ 25°C 10% Deflection measured axially ASTM D-1621-16	240
Thermal Conductivity W/moC @ 25°C ASTM D-2326-70	0.0187
Operating temperature range °C Cyrogenic to +	93
Closed cell content - % ASTM D-2856-13	90 min
Water absorption gm/1000 cc ASTM D-2842-12	12
Dimensional Stability, % ASTM D-2126-15 Procedure B & E	3

.7 Warning Tape

.1 The warning tape of water mains shall be 150 mm wide by 0.15 mm polyethylene tape. It shall be blue in colour and have a factory applied marking at one metre intervals, i.e., "Caution Buried Water Line". The standard of acceptance shall be Decto Tape by Allan Systems.

.8 Field Joint Sleeves

.1 Wrap sleeves for field fusion joints and for flanged connections to vaults shall be 2.7 mm thick. Canusa Wrap LPW or equal. Each wrap will conform to the manufacturer's recommended width and length for each size of pipe.

.9 Heat Shrink Tape

.1 Heat shrink tape shall be 150 mm wide with the standard of acceptance being Raychem Thermoclad.

.10 Half Shells

.1 Half shells shall be made of urethane insulation with the properties as described in Section 2.1.2, and shall have a thickness equivalent to the urethane insulation on the pipe.

.11 Field Applied Urethane

.1 Field applied urethane shall be "Portafoam" manufactured by Insta-Foam Products Inc., or equivalent.

.12 Pipe Bedding

.1 Pipe bedding shall be conforming to the specifications for Type 5, as listed in Section 32 11 10 – Aggregates General.

.13 Trench Insulation

.1 Trench Insulation shall be Styrofoam HI-40, 2440mm wide 50mm thick or 100mm thick

Part 3 Execution

3.1 DRAINAGE

.1 The Contractor shall keep all portions of the work properly and efficiently drained during construction and until completion. He shall be held responsible for all damage that may be caused as the result of water backing up or flowing over, through, from, or along any part of the work or surrounding properties due to his operation.

.2 All costs associated with providing drainage for the work as required, shall be included in the unit prices for the installation of each associated item.

3.2 SITE RESTRICTIONS

.1 When planning the work, the Contractor shall make due allowance for the presence of the existing structures, access, utilities and the operation of others on the site.

.2 Supports, adequate protection and maintenance of all existing underground and surface utility structures, drains, sewers, ducts, conduits, power poles and other obstructions encountered during the progress of the work, shall be provided by the Contractor at his own expense.

3.3 INSPECTION

.1 All material is subject to inspection and testing for soundness and suitability at the discretion of the Engineer.

.2 All works shall be undertaken in strict adherence to the manufacturer's instructions, which are considered as being part of these Specifications. As each section of the work is completed, it shall be tested in the manner specified, and in the presence of, and as approved by, the Engineer.

.3 All material found, during the progress of the work, to have cracks, flaws, or other defects, or to be of doubtful quality will be rejected by the Engineer. All rejected materials shall be promptly removed from the site of the work by the Contractor and all costs associated with the removal and replacement of rejected material shall be borne by the Contractor.

3.4 HANDLING OF MATERIAL

.1 The material shall be delivered and distributed at the site by the Contractor. All pipe and accessories shall be loaded and unloaded by lifting manually or with hoists so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Insulated pipe shall not be skidded on the ground or against pipe already on the ground.

.2 In distributing the polyethylene pipe at the site of the work, each piece shall be unloaded opposite or near the place where it is to be installed.

.3 Pipe shall be handled so the exterior and interior surfaces, prefabricated joints, insulation etc., will not be damaged. If, however, any part of any surface, coating or lining is damaged, the repair shall be made by the Contractor at his own expense, in a manner satisfactory to the Engineer.

3.5 ALIGNMENT AND GRADE

.1 All pipe sections shall be laid and maintained to the required lines and grades, with fittings valves, hydrants, access vaults, etc., at the proper locations; with joints centred.

.2 No deviation from authorized lines and grades shall be made without the written approval of the Engineer. If, in the opinion of the Engineer, the Contractor's method of setting grades is inaccurate or insufficient, the Engineer may direct that more suitable equipment and methods be used to insure that proper grades are established.

3.6 WATER IN EXCAVATION

.1 Work shall be carried out in a dry trench. Water shall not be allowed to run over the invert, reach the joints, or run through the pipe sections during construction.

.2 All water pumped or drained from the work shall be disposed of in a suitable manner satisfactory to the Engineer, without damage to the Construction work of other property, structures, or persons.

3.7 PIPE BEDDING

.1 Insulated piping shall be bedded in Type with a minimum of 0.15 m below the insulation, 0.15 m on both sides and 0.30 m above the insulation of the piping. Mechanical tamping of the pipe bedding shall be carried out in 0.15 m loose layers.

.2 The pipe bedding shall be compacted to 95% Standard Proctor Dry Density as per ASTM D698-07e1. Compaction in a wet trench will not be acceptable.

.3 Bedding shall be deemed unsatisfactory if, in the opinion of the Engineer, compaction cannot be obtained because of the presence of water.

.4 No extra payment shall be made for the replacement of bedding that has become unsatisfactory due to water from any source

3.8 WARNING TAPE

.1 A continuous run of "warning" tape shall be laid on the pipe bedding 0.6 m directly above the water main.

3.9 FIELD APPLIED URETHANE

.1 Field spraying of urethane will be carried out by experienced operators only using "Insta-Foam Froth-Pak" kits or approved equal. Exposed urethane shall be coated with 1 mm of Flint Kote-Superior Asphalt Mastic No. 110-14 and heat shrink sleeves. Where geometry does not permit the use of heat shrink sleeves, two layers of Raychem Thermoclad 150 mm wide tape with 50% overlap shall be used.

3.10 PIPE LAYING

.1 Lengths of polyethylene pipe water mains to be laid between flanged fittings on access vaults shall be assembled on dry ground by butt-fusion, complete with flanged ends. The pipe shall be pressure tested (as described in Clause 3.12) and installation of urethane half shells shall be completed prior to laying the pipe in the trench. To prevent the entry of rubbish, blind flanges shall be installed on the ends of mains prior to installation in the trench and shall only be removed immediately prior to connection to the access vault.

.2 The water mains shall be laid to the alignment and grades shown on the drawings.

.3 It is prohibited to drag pipe over the ground which would damage the black jacket or insulation. If the pipe or fused sections of the pipe are to be moved, they must be supported on rollers or completely suspended.

.4 Slings used to lower the insulated pipe into the trench shall support the pipe without causing damage to the jacketing insulation (see Clause 3.4).

3.11 PIPE JOINTS

.1 The insulation shall be cut back 190 mm, as shown on the drawing to allow for the field joining of the pipe. Care shall be taken, when cutting away insulation from the pipe, not to cut the pipe beneath the insulation. Cut pipe shall be rejected from the work. Field cut insulation shall be treated with mastic.

.2 Thermal butt-fusion of polyethylene pipe shall be carried out as recommended by the supplier, but only by a certified butt-fusion technician.

.3 When joining the sections of pipe, it is the fusion equipment that must be moved from joint to joint.

.4 Should it become necessary, and only upon authorization by the Engineer, polyethylene spacer blocks, properly machined, and of the same material as the main, may be used when required to connect the mains to the access vaults. The spacer blocks shall be installed between the flanges. Only one spacer block is permitted for each connection.

.5 Back up flanges for flange connections shall be ductile iron. Bolts shall be galvanized or cadmium plated. All required bolts and gaskets shall be provided by the Contractor.

.6 Where the drawings call for the use of heat shrink tape or where the geometry of bends and fittings prevents the installation of heat shrink sleeves over the insulation then two wrappings of heat shrink tape in 150 mm widths shall be applied. The first complete wrapping shall be applied and shrunk down before the second wrapping is applied. The tape shall overlap 50% as it is wrapped around the pipe of fitting. These methods shall be used to repair all damage to insulation jacketing.

3.12 PRESSURE TESTING OF POLYETHYLENE PIPE

.1 A pressure test shall be performed on each section of water main, before the insulation of the joints or installation in the trench. A section of water main shall be considered to consist of a length of pipe between two (2) flanged fittings.

.2 The purpose of the pressure test is to verify all joint and pipe integrity.

.3 The Contractor shall provide all necessary labour, materials and equipment for the test including a suitable pump and measuring tank, pressure hoses, connection plugs, caps, gauges and all other apparatus necessary for filling the pipe, applying the required test pressure, and record the pressure losses.

.4 Water shall be used for testing. The Contractor shall provide temporary heating and additional insulation as required to keep the water in the pipe from freezing.

.5 Payment for the cost of testing shall be included in the unit price tendered for installation of the water main.

.6 The ends of the pipe to be tested shall be sealed off using blind flanges and gaskets. The flange on the lower end of the pipe shall be tapped to receive the test pump discharge line. The flange on the high end of the pipe shall be tapped to receive a vent cock to discharge air from the line during the filling process. The pipe shall be laid to a continuously rising grade to the vent cock.

.7 The pipe shall be filled with water at a gauge pressure of 1.5 times the series rating of the pipe. No pressure drop will be allowed during this period and maintained for one hour. All leaks or defective material shall be repaired to the Engineer's requirements, or replaced. Any section requiring repair shall be retested.

.8 Sections of water main shall be installed only after passing the pressure test as outlined above.

3.13 PRESSURE TEST WATER SYSTEM

.1 After the water main system, complete with fittings, valves and hydrants, has been installed, but before making connection to the existing mains, the system shall be pressure tested. The pressure test shall be performed on each section of water main. A section of water main shall be considered to consist of a length of pipe between two (2) valves.

.2 The purpose of the pressure test is to verify the integrity of all joints, pipes, and valves.

.3 The Contractor shall provide all necessary labour, materials and equipment for the test including a suitable pump and measuring tank, pressure hoses, connection plugs, caps, gauges and all other apparatus necessary for filling the pipe, applying the required test pressure, and record the pressure losses.

.4 Water shall be used for testing. The Contractor shall provide temporary heating and additional insulation as required to keep the water in the pipe from freezing.

.5 Payment for the cost of testing shall be included in the unit price tendered for installation of the water main.

.6 The valves at each end of a section of pipe shall be closed and the pipe shall be filled with water at a gauge pressure of 1.5 times the series rating of the pipe. The test pressure shall be maintained for an initial period of 4 hours and then reduced by 70 kPa, then held at the reduced pressure for a second period of 1 hour minimum to 3 hours maximum duration. During the second period of the test, the joints on water main fittings, valves, hydrants, etc., in access vaults shall be inspected.

.7 The 70 kPa reduction in pipe pressure after 4 hours of pressurizing compensates for pipe stretch. No water loss allowance shall be made in the second period of the test for pipe stretch.

.8 When testing sections of the pipe, the pressure difference is to be maintained across the valve to test the valve. Therefore, two adjacent sections of pipe can not be tested simultaneously.

.9 Upon completion of the pressure test, the on the flanged connection on the exterior of the access vault shall be retighten and the access vault backfilled.

.10 Certificates indicating satisfactory pressure testing must be provided with progress claims.

3.14 DISINFECTION OF WATER MAINS

.1 Prior to disinfection, all water mains shall be thoroughly flushed to remove any debris. The Contractor shall be responsible for making arrangements with the local municipal authority to use local municipal water for flushing.

.2 Before being placed into service, all new water mains shall be chlorinated throughout their entire length. The method to be used to introduce the disinfectant into the line must be approved by the Engineer and the Department of Health. Chlorine must be added to attain

a concentration of 100 parts per million throughout the system and this solution will then be retained for 12 hours, after which time the chlorine concentration must not have dropped below 5 ppm. During chlorination, all valves and accessories shall be operated, make up water being chlorinated at 100 ppm. After chlorination is completed, the mains shall be flushed throughout until the replacement water is equal chemically and bacteriologically to the supply. These tests must be made in the presence of the Engineer. Satisfactory bacteriological test results must be obtained prior to commissioning the system.

.3 On completion of the chlorination of the mains, the Contractor shall set the system in operation and supply the necessary labour for the opening or closing of all valves as required or drain the system and pump all mains and services dry, as directed by the Engineer.

.4 The cost of disinfection and putting the mains into service pumping the mains and services dry shall be included in the unit price for the mains.

3.15 TEST FOR OBSTRUCTION

.1 Upon completion of backfilling, water mains shall be tested for obstructions. The Contractor shall provide and pay for all labour, tools, rope, pigs, lights and other equipment required to examine all work as required by the Engineer. The cost of this testing shall be included in the unit prices tendered for the installation of water mains.

.2 The water mains shall be tested for obstructions using a pig test. The pipes shall be deemed unobstructed if a wood or metal ball, having a diameter 19 mm less than the inside diameter of the pipe can be readily pulled through the line. This test shall be performed prior to flushing and chlorination.

3.16 JOINT TESTING

.1 The Owner reserves the right to visually inspection and test fusion joints using non-destructive methods.

3.17 INPECTION CERTIFICATES

.1 Written inspection certificates shall be issued to the Contractor for various phases of the work after the work has been inspected by the Engineer and has been found to comply with the Plans and Specifications. Inspection certificates are required for work that is to be covered by other work or backfill.

.2 Payment shall not be made for work requiring an inspection certificate until the certificate has been issued by the Engineer. The Engineer shall issue an inspection certificate immediately after approval of a phase of the work.

.3 The issuance of an inspection certificate shall not relieve the Contractor from his obligation to maintain the work or replace work subsequently found to be faulty.

.4 The temporary absence of the Engineer from the site shall not relieve the Contractor from his obligation to obtain inspection certificates.

3.18 RELOCATION OF MAINS

.1 The Engineer has the right to relocate the mains throughout the project and he will advise the Contractor well in advance of the work if any such move is contemplated.

3.19 TRENCH INSULATION

.1 50mm thick, 2440mm styrofoam HI-40 trench insulation boards should be laid side by side on 300mm compacted Type 5 fill.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 03 30 00 - Cast-in-Place Concrete
.2 Section 31 23 33 - Excavating, Trenching and Backfilling
.3 Section 31 37 00 – Rip Rap
.4 Section 32 11 10 - Aggregates General
.5 Section 32 25 00 - Roadways

1.2 REFERENCES

.1 ASTM International

.1 ASTM D698-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft;) (600kN-m/m;).

.2 CSA International

.1 CAN/CSA G401-07, Corrugated Steel Pipe Products.

1.3 MEASUREMENT AND PAYMENT

.1 The measurement of completed work shall be by the linear metre of culvert, as measured by the Engineer. All quantities measured by the Engineer shall be final.

.2 Payment shall be by the linear metre of pipe culvert.

1.4 MATERIAL CERTIFICATION

.1 Submit manufacturer's test data and certification at least 4 weeks prior to commencing work.

.2 Certification to be marked on pipe.

Part 2 Products

2.1 MATERIALS

.1 Corrugated Steel Pipel

.1 Corrugated steel pipe: to CAN/CSA G401-14.
.2 Water-tight cut-off collars: as indicated.
.3 Prefabricated end sections: as indicated.
.4 Corrugated fluming: to CAN/CSA G401-14.

.2 Granular Bedding and Backfill

.1 Granular bedding and backfill shall conform to the specifications for as listed in Section 32 11 10 - Aggregates General.

.2 Concrete mixes and materials for bedding, cradles, encasement, supports: to Section 03 30 00: Cast-in-Place Concrete.

Part 3 Execution

3.1 TRENCHING

.1 Do trenching work in accordance with Section 31 23 33: Excavating Trenching and Backfilling.

.2 Obtain Engineer's approval of trench line and depth prior to placing bedding material or pipe.

3.2 BEDDING

.1 Dewater excavation, as necessary, to allow placement of culvert bedding in the dry.

.2 Place minimum thickness of 200 mm of approved granular material on bottom of excavation and compact to 95% Standard Proctor Dry Density as per ASTM D698-12.

.3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to camber as indicated or as directed by Engineer, free from sags or high points.

.4 Place bedding in unfrozen condition.

3.3 LAYING CORRUGATED STEEL PIPE CULVERTS

.1 Commence pipe placing at downstream end.

.2 Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length.

.3 Lay pipe with outside circumferential laps facing upstream and longitudinal laps or seams at side or quarter points.

.4 Lay paved invert or partially lined pipe with longitudinal centre line of paved segment coinciding with flow line.

.5 Do not allow water to flow through pipes during construction except as permitted by Engineer.

3.4 JOINTS CORRUGATED STEEL PIPE CULVETSH

.1 Corrugated steel pipe:

.1 Match corrugations or indentations of coupler with pipe sections before tightening.

.2 Tap couplers firmly as they are being tightened, to take up slack and ensure snug fit.

.3 Insert and tighten bolts.

.4 Repair spots where damage has occurred to spelter coating by applying two coats of asphalt paint approved by Engineer.

.2 Structural plate:

.1 Erect in final position by connecting plates with bolts at longitudinal and circumferential seams.

.2 Drift pins may be used to facilitate matching of holes.

.3 Place plates in sequence recommended by manufacturer with joints staggered so that not more than three plates come together at any one point.

.4 Draw bolts up tight, without overstress, before beginning backfill.

.5 Repair spots where damage has occurred to spelter coating by applying two coats of asphalt paint approved by Engineer.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C83-96 (R2011), Communication and Power Line Hardware.

.2 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

1.2 COORDINATION WITH POWER SUPPLY AUTHORITY

.1 Coordinate and meet requirements of power supply authority. Ensure availability of power when required.

.2 Arrange with the local utility company to supply and install a new overhead power line from the existing transformer adjacent to the building as indicated on the drawings.

.3 Be responsible for obtaining the correct location and for scheduling the installation of the transformer with the utility company.

.4 Ascertain the electrical utility charges and include this amount in the contract price for the complete service.

1.3 SCOPE

.1 Installations for 750 volt or less. Refer to Canadian Electrical Code.

Part 2 Products

2.1 MATERIAL

.1 Service Mast: Rigid steel conduit minimum 100mm trade size suitable for attachment of support clamps, insulator rack, weatherhead, service drop fittings.

.2 Other means accepted by local authority.

.3 Insulator Rack: To CAN/CSA-C83, four wire, heavy duty.

.4 Weatherhead: Rain tight and cast metal. To the approval of supply authority.

.5 Meter base must be metal enclosure and meet Canadian Electrical Code and have the approval of the supply authority.

Part 3 Execution

3.1 INSTALLATION

.1 Install service mast, insulator rack, weatherhead as per methods in compliance with Canadian Electrical Code and local approved methods.

.2 Install metal meter base and conduit in locations in Canadian Electrical Code or locally approved locations. Meter must be located as close as practical to the service and grouped where practical.

.3 Install service drop conductors as per methods in Canadian Electrical Code or local approved methods.

.4 Conductor length for connection to supply shall be a minimum of 1000 mm and shall be provided with adequate conductor length for drip loops.

.5 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary, Canadian Electrical Code and instructions from local authority.

3.2 TESTING

.1 Perform tests in accordance with Section 26 05 02 – Testing, Verification, Commissioning and Training Electrical Systems.

.2 Perform additional tests if required by authority having jurisdiction.

END OF SECTION