PROCUREMENT SERVICES

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ADDENDUM No. 3

INVITATION TO TENDER No.:	**1220-020-2020-003**
TITLE:	**ENERGY TRANSFER STATIONS (ETS) AND INTERIOR PIPING CONSTRUCTION AT PCI**
ADDENDUM ISSUE DATE:	**April 7, 2020**
REVISED CLOSING TIME:	**ON OR BEFORE THE FOLLOWING DATE AND TIME (THE "CLOSING TIME"):** **TIME: 11:00 A.M.** **DATE: APRIL 15, 2020**

INFORMATION FOR TENDERERS

Tenderers are advised that this Addendum No. 3 to Contract No. 1220-020-2020-003 is hereby issued by the *Owner*. This addendum shall form part of the *Contract Documents* and is to be ready, interpreted and coordinated with all other parts. The following revisions supersede the information contained in the original *Contract Documents* and preceding addendums (if any). The cost of all *Work* herein shall be included in the *Unit Prices* tendered in the *Schedule of Quantities and Prices*.

Question(s) and Answer(s):

Q.1 There is no piping specification for type C01 (for domestic hot water).

A.1 **The piping material should match the building's material – either C01 or SS01 piping is okay as mentioned on page 15 of section 01110 for the DHW secondary piping. Our specification in section 15099 for C01 piping is for 2" or less, however, for this application 4" C01 piping to ASTM B88 is okay.**

Please refer to the attached document for reference.

- END OF ADDENDUM -

All Addenda will become part of the ITT Documents.

LIST OF SPECIFICATIONS

DIVISION 00

DIVISION 01 GENERAL REQUIREMENTS

END OF SECTION

2020-02-24

LIST OF STANDARD SPECIFICATIONS

DIVISION 03 CONCRETE

Section 03050 CAST-IN-PLACE CONCRETE

DIVISION 11 MAJOR EQUIPMENT

Section 11500 HEAT EXCHANGERS

DIVISION 15 MECHANICAL

Section 15009 BASIC MECHANICAL METHODS
Section 15070 SEISMIC RESTRAINT SYSTEMS
Section 15098 HOT WATER PIPING
Section 15099 PIPE SPECIFICATION SHEETS
Section 15108 VALVES
Section 15109 VALVE SPECIFICATION SHEETS
Section 15260 HANGERS AND SUPPORTS
Section 15280 FIELD INSULATION
Section 15736 PIPE CONDITIONING

DIVISION 16 ELECTRICAL

Section 16010 GENERAL PROVISIONS
Section 16100 BASIC MATERIALS
Section 16400 SERVICE AND DISTRIBUTION
Section 16905 CONTROLS AND INSTRUMENTATION

END OF SECTION

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PART 1 GENERAL

1.1 Definitions

.1 Owner: "Owner" of City of Surrey; contact information: Derrick Moore at 604 591 4092 or DMoore@surrey.ca, Newton Conti at 604 591 4381 or Newton.Conti@surrey.ca and Emily Kwok at 604 592 7027 or Emily.Kwok@surrey.ca.

.2 Project: "Project" is the City of Surrey Energy Transfer Stations (ETS) Construction of Package 2.

.3 Engineer: "Engineer" means the Engineer of the Owner and any person duly authorized to act on her behalf; the Engineer is Kerr Wood Leidal; contact information: Abby Dacho at 604-293-3268 or ADacho@kwl.ca.

.4 Consultant: Within these specifications the word "Consultant" is synonymous with the word "Engineer".

.5 Vendor or Supplier: "Vendor" or "Supplier" means the person, or persons, or a company whose quotation has been accepted by the Owner in the form of an authorized Purchase Order.

.6 Purchase Order: "Purchase Order" means the authorized Contract, issued by the Owner, accepting the Vendor's quotation.

.7 Contractor: "Contractor" means the person, or persons, or a company whose quotation has been accepted by the Owner to install and construct the materials provided by the Vendor.

.8 Work: "Work" means all labour, equipment, materials and incidentals performed by the Contractor for completion of Energy Transfer Station and Distribution Piping System.

.9 Owner Representative or Contract Administrator: "Owner Representative" or "Contract Administrator" refers to the Owner, or any person duly authorized to act on behalf of the Owner.

1.2 Background

.1 The City of Surrey is extending their district energy distribution infrastructure to include PCI King George Hub Phase B (E-17570), Buildings B2, B3, B4 and B5. The ETS room for all buildings will be located in B2.

.2 While performing this Work maintaining a safe work site and coordination with other construction crews is of the utmost importance.

.3 This Specification package covers Mechanical and Electrical requirements for the supply and installation of the ETS service connections, including piping within the ETS room, the ETS itself, and controls requirements.

.4 The exterior piping connection and internal piping to the ETS mechanical room is described in a separate specification package.

1.3 Scope

.1 The work of this Contract consists of the supply and installation of materials, including all labour, equipment, and tools related to the ETS connections, in accordance with the drawings and specifications, for the prices tendered.

.2 General scope items **included** are as follows:

.1 Obtaining and paying for all permits, licences, and fees required from the regulatory authorities having jurisdiction; including the BC Safety Authority.

.2 Coordinate with other trades / contractors in common work spaces, including coordination with Civil contractor for installation of exterior piping.

.3 Coordinate delivery, handling and storage of material / equipment.

.4 Inspection and acceptance of equipment following delivery.

.5 Load, transport and deliver all excess Owner-Supplied material to Owner's storage area, if required.

.6 Ensure equipment conforms to the project specifications.

.7 Report any visible damage or non-conformance to the Contract Administrator of any missing items that will be required for construction, prior to starting construction.

.8 Contractor to allow for mobilization and demobilization assuming this project may be done in multiple stages with separate timeframes for the installation of the Energy Transfer Stations. Refer to the Schedule in the Front End.

.9 Buildings are currently active construction sites and ETS area shall be protected from damage or tampering by other contractors/personnel during construction by means of temporary physical structures. If construction concludes prior to energization or substantial completion, protection shall remain until ETS is handed off to Owner. Following acceptance of each ETS Contractor shall remove protection prior to handover.

.3 The mechanical scope **includes** but is not limited to the following:

.1 Supplying and installation of all heat exchangers, piping, equipment, supports, insulation, jacketing, controls and accessories within the ETS room as listed in the project schematics, drawings and specifications.

.2 Installation of all material / equipment as per manufacturer recommendations.

.3 Housekeeping pads for all equipment and pipe supports in the contractor's scope of work. If ETS skid is proposed, housekeeping pads are not required; however it is the contractor's responsibility to ensure the skid can be installed on site.

.4 Flushing, pressure testing, chemical cleaning and passivation of all piping.

.5 Performing all required quality assurance procedures including but not limited to weld X-rays, pressure testing, and water quality testing.

.6 Tie-in to the existing DPS connections.

.7 Coordinating inspection with Technical Safety BC and any other required inspections.

.8 Seismic review and sign off by a registered professional engineer in BC on all hangers and supports.

.9 Coring and firestopping of interior walls.

.10 Coordination with building mechanical contractor and City of Surrey for start-up/commissioning/tie-in (Refer to tie-in List in Part 2).

.11 Commissioning of the interior piping and ETS once building is ready to accept thermal energy (coordinated with City of Surrey staff).

.4 Electrical scope / Controls items **included** are as follows:

.1 Provide all labour, materials, equipment, services and supervision required to provide a complete electrical and control system as described in Division 16 and as described in other Sections of this specification.

.2 Coordinate electrical and controls work with the General Contractor's overall working schedule and cooperate to achieve the earliest possible completion of the work.

.3 This includes, but is not limited to the following:

.1 Wire/conduit and Cabling;
.2 Wiring Terminations and Identification;
.3 Programmable Logic Controllers;
.4 Control Panel(s);
.5 Programming of the Operator Interface Panel;
.6 Instrumentation;
.7 Uninterruptable Power Supply (UPS);
.8 Provision for Communications; and
.9 Testing and Commissioning.

.4 All control panels and instruments shall be factory calibrated, assembled, cleaned, inspected, and successfully tested prior to shipping, with a report or certificate of successful test to be sent to the City of Surrey.

.5 Provision for installation of current switches on secondary distribution pumps and wiring to the ETS utilizing conduit provided by the base building contractor as noted on the drawings.

.6 Installation of EMT conduit and fibre optic cable from the building wall penetration to the ETS control panel.

.7 The ETS shall have its own standalone Control Panel that will maintain the sequence of operation as outlined in Section 16905 - Part 4. Refer to Section 16905 - Part 2.3.12 for the communication protocol of the buildings in the scope of work. The Contractor will be responsible for providing power to the Control Panel from within the mechanical room.

.8 Controls shall be contractor supplied. The contractor shall provide a system that allows for:

.1 Local minute to minute logging and extraction of data for local control points from the ETS.

.2 Control hardware must be fibre compatible.

.3 ETS graphics including OAT reset scale for secondary heating that can be adjusted by the user

.4 Control panel shall be connected to the local building management system (BMS) for monitoring

.5 Four (4) hours of control training for City of Surrey staff for each ETS (12 hours total)

.6 One (1) day for coordination and review of alarm setup and trending data with City of Surrey operations.

.5 Scope **excluded** is as follows. The Contractor shall co-ordinate their work with the following work and co-operate where required.

.1 Installation of communication conduit from the ETS room to secondary pumps.

.2 120/240V power supply circuit to the mechanical room.

1.4 Design Parameters

.1 Primary Piping Operating Temperature: 85 °C (185 °F).

.2 Primary Piping Design Temperature Rating: 120 °C (248 °F).

.3 Primary Piping Design Pressure: 1,600 kPa (232 psi).

.4 Secondary Domestic Hot Water Piping Design Temperature Rating: 100 °C (212 °F).

.5 Secondary Domestic Hot Water Piping Design Pressure: 1,034 kPa (150 psi) minimum and as noted on P&ID drawings for higher pressure systems.

.6 Secondary Heating Hot Water Piping Design Temperature Rating: 100°C (212 °F)

.7 Secondary Heating Hot Water Piping Design Pressure: 1,034 kPa (150 psi) minimum and as noted on P&ID drawings for higher pressure systems.

.8 Maximum Ambient Temperature: 40 °C (104 °F).

.9 Seismic Zone: as per the BC Building Code.

1.5 Submittals

.1 The required submittals are detailed in Section 01330. The contractor is required to submit a compliance statement along with the form of tender. Note that red line drawings must be submitted for the work completed.

1.6 Local Jurisdiction

.1 The following authorities have jurisdiction over this project:

.1 Technical Safety BC (TSBC),

.2 BC Building Code,

.3 BC Plumbing Code,

.4 BC Electrical Code,

.5 City of Surrey, and

.6 WorkSafeBC.

1.7 Limits of Work Sites

.1 The work sites are limited to the areas shown on the drawings.

.2 Contractor to coordinate material lay-down area with building contractors.

1.8 Drawings

.1 The Contractor shall examine all drawings in advance of construction and shall advise the Contract Administrator of any apparent errors, discrepancies or inconsistencies, in order that the Contract Administrator can provide instructions clarifying the design.

.2 The Contractor shall also advise the Contract Administrator of any discrepancies or apparent inconsistencies between the drawings and the specifications, in order that the Contract Administrator may clarify the intent of the Contract.

1.9 Testing and Start-up

.1 The Contractor shall be responsible for all aspects of the testing and start-up of the system. Start-up is to be coordinated with City of Surrey operational staff.

.2 Detailed requirements for each system and item of equipment are provided in the appropriate specification sections.

.3 It is the Contractor's responsibility to coordinate any required inspections with Technical Safety BC.

1.10 Costs for Testing, Engineering and Inspection

.1 The cost of required third party testing as described in the contract documents will be borne by the Contractor. This includes but is not limited to the following:

.1 Weld testing / inspections; and

.2 Water quality testing.

.2 At their discretion, the Owner may employ an independent testing firm to conduct quality control tests to determine compliance of the work with the Contract Documents. Should material or workmanship be found to be unacceptable, the full cost of further testing relating to the deficiency shall be charged to the Contractor.

.3 The Contractor shall have no claim for delays, interruptions, double-handling of materials, rejection of materials, or any other cause brought about by such tests, including awaiting the outcome of such tests.

.4 Provide adequate notice to the Contract Administrator to permit testing to be conducted at appropriate times in an efficient manner.

.5 Provide material samples to the Contract Administrator in such quantities as required for testing for conformance with the specification. Make good, at least to original standard, area from where samples are taken.

1.11 Addenda

.1 Addenda or corrections issued during the bid period shall become part of the Bid Documents.

1.12 Variations

.1 Subject to the requirements given herein, the bidder may submit for consideration, alternative specifications for the Work. These shall be listed accordingly in the Bid Form. The acceptability of proposed variations/exceptions will be in the sole judgement of the Owner.

1.13 Discrepancies and Omissions

.1 If a bidder is in doubt as to the meaning of the specifications or Tender documents, or finds omissions or discrepancies therein, they shall submit a request for interpretation or correction thereof to the Owner. In case a discrepancy is not brought forward, the more expensive solution should be assumed.

PART 2 TIE-IN LIST

.1 The following tie in points will be required.

Tie-In #	Description	Drawing #	Building Serviced	Connection Type	Contractor Responsible for Tie In	Notes
TP 06A/B	ETS Tie-in to Primary Hot Water (Supply/Return)	D-106	E-17570 B2-B5	Welded	Contractor	1,3
TP 06C/D	B2 Secondary Heating Side Tie-in (Supply/Return)	D-107	E-17570 B2	Flanged	Contractor	2,3
TP 06E/F	B3 Secondary Heating Side Tie-in (Supply/Return)	D-108	E-17570 B3	Flanged	Contractor	2,3
TP 06G/H	B3 Secondary DHW Tie-in (Supply/Return)	D-108	E-17570 B3	Flanged	Contractor	2,3
TP 06I/J	B4 Secondary Heating Side Tie-in (Supply/Return)	D-109	E-17570 B4	Welded	Contractor	1,3
TP 06K/L	B4 Secondary DHW Tie-in (Supply/Return)	D-109	E-17570 B4	Flanged	Contractor	2,3
TP 06M/N	B5 Secondary Heating Side Tie-in (Supply/Return)	D-110	E-17570 B5	Flanged	Contractor	2,3

Notes:
1. Contractor to verify as-constructed DPS interior termination points. If a flange exists, cut and dispose.
2. Contractor to coordinate location of secondary tie-in points with the building Contractor.
3. Controls to be connected from building penetration fibre conduit termination to ETS control panel. Contractor to provide secondary pump current sensors (as noted on P&ID) and wiring to connected to the ETS control panel, through base building-provided conduit.

PART 3 SCHEDULE

3.1 Schedule

.1 All products / materials included in this scope shall be delivered as per the work Schedule as stated in the Front-End.

.2 The Contractor is required to complete required Work in advance of provided building service request dates and where firm schedule drivers are provided.

.3 Contractor must coordinate its construction schedule with the building contractor, the current operational requirements of the building and any other construction forces working in the area.

.4 Any Work impacting plant operations must be coordinated with and approved by City of Surrey operations staff.

.5 The Contractor shall commence work under the Contract within 10 business days of the Notice to Proceed.

.6 Contractor shall submit shop drawings for all Contractor supplied materials for review and approval within 15 business days of award.

.7 The agreed dates for commencement of work and substantial performance of the work shall be those set out in the Agreement.

.8 The Contractor is to take into account all factors that might affect the schedule, including weather conditions that can reasonably be expected within the time frame that the work is to be done.

.9 Refer to the General Conditions regarding delays.

3.2 Sequence of Construction

.1 The Contractor shall carry out the work of this Contract such that all aspects of the work are completed under conditions necessary for construction, installation or application of materials as required by the manufacturer or by the Contract.

.2 Schedule the work such that inconvenience to residents in the working area is kept to a minimum.

PART 4 MATERIAL SUPPLIED

4.1 Materials and Equipment Supplied by the Owner

.1 No materials will be owner supplied.

4.2 Materials and Equipment Supplied by the Contractor

.1 The Contractor shall supply all materials and shall:

.1 Find, load, haul, unload, store and care for all such materials, the cost of which shall be included in the tendered price.

.2 Pay all freight, duty, royalties, wharfage, sales tax and other charges on the materials they furnished under this contract.

.3 Be responsible for the proper handling of all pipe, fittings, and appurtenances; any damage which may be done in handling, shipping, storage, or in any other way prior to acceptance after installation and testing shall be made good by the Contractor at their expense.

.2 All materials incorporated into the work shall conform to this contract and to the latest edition of the appropriate specification of the ASTM, or to other standards expressly specified. Workmanship shall be first class and in accordance with the best shop practice.

.3 All materials incorporated in the work and materials not specifically covered in the specifications shall be new, of good quality, and acceptable to the Contract Administrator.

.4 All items supplied by the Contractor shall be as specified. If the Contractor wishes to supply and install items other than specified, they shall apply for and must receive written permission from the Contract Administrator before incorporating such items into the work.

.5 Descriptive literature and price schedules covering such alternative items shall be supplied to the Contract Administrator at least 10 working days in advance of the required approval.

.6 Equipment supplied by the Contractor shall include installation, operating and maintenance manuals.

PART 5 EXCEPTIONS TO THE KWL STANDARD SPECIFICATION

.1 Section 03050 CAST-IN-PLACE CONCRETE: no exceptions.

.2 Section 11500 HEAT EXCHANGERS

.1 Delete Section 2.5 Type HX04 from the specification.

.2 Part 2.4: Add the following:

Provide drainage pan with moisture sensor below heat exchanger.

.3 Section 15009 BASIC MECHANICAL METHODS: no exceptions.

.4 Section 15070 SEISMIC RESTRAINT SYSTEMS: no exceptions.

.5 Section 15098 HOT WATER PIPING

.1 Part 3.1 Add the following:

Provide dielectric couplings between all dissimilar materials.

.2 Delete parts 3.11 and 3.12.

.6 Section 15099 PIPE SPECIFICATION SHEETS: no exceptions.

.7 Section 15108 VALVES

.1 Part 1.5: Add the following:

Contractor shall be responsible for coordinating all delivery, storage and handling.

.2 Part 3.3.4: Replace with the following:

Provide vents at all high points. Vents should be piped to within 0.4 m from the ground, as per drawing details. All Vents should be piped such that the outlet points towards the ground.

.8 Section 15109 VALVE SPECIFICATION SHEETS

.1 CRN is exempted for valves complying with a standard listed in Table 126.1 of ASME B31.1, Table 326.1 of ASME B31.3, Table 526.1 of ASME B31.5, or Table 926.1 of ASME B31.9.

.2 Delete valve type BF-01. Butterfly valves will not be accepted on this project.

.3 BV-01: Welded ball valve: Note the following:

Flanged ball valves will not be accepted on the primary side of the ETS.

.4 BV-03: Where copper piping is used, BV-03 should be replaced with a brass ball valve.

Ball Valve	**BV-03 (Brass)**
General	
Description	Two-piece cast bronze ball valve
Basic Material & Reference Standard	Cast bronze
Ends	Refer to piping spec section 15099
Pressure Rating	2,760 kPa (400 psi)
Temperature Rating	Match piping design temperature
Size Range	65 – 100 mm (2 1/2" to 4")
Service	Domestic Hot Water Secondary Side Isolation, Drain, Vent and Gauges
Materials	
Body	Cast bronze or Forged Brass
Ball	Brass
Seat	PTFE
Stem	Brass rod
Notes	
1. Blowout-proof stem. 2. All valves shall have a registered CRN number as required by the local safety authority. 3. Must be NSF/ANSI 61 rated for potable water service.	
Standard of Acceptance	
KITZ Code #59 – Cast Bronze / Forged Brass Ball Valve	

.9 Section 15260 HANGERS AND SUPPORTS: no exceptions.

.10 Section 15280 FIELD INSULATION

.11 Part 1.6: Add the following:

Contractor shall be responsible for coordinating all delivery, storage and handling.

Part 2.6.5: Replace with the following:

Minimum insulation thickness is 50 mm.

.12 Section 15736 PIPE CONDITIONING: no exceptions.

.13 Section 16010 ELECTRICAL GENERAL REQUIREMENTS

.14 Part 3.20.3: Replace with the following:

Contractor shall be responsible for coordinating all transport, delivery, storage and handling.

.15 Section 16100 BASIC MATERIALS: no exceptions.

.16 Section 16400 ELECTRICAL SERVICE AND DISTRIBUTION: no exceptions.

.17 Section 16905 CONTROLS:

.1 Part 2.2.1: Replace with the following:

The ETS Control Panel shall be powered by means of a Line Interactive type UPS.

.2 Add 2.2.4: UPS shall be installed in an enclosure where it is:

Protected from water damage, tamper-proof (lockable enclosure to avoid shutoff, and ventilated.

.3 Replace 2.4.2: The ECS shall be capable of communicating with a central monitoring facility through fibre connection.

.4 Add 2.4.3: Pre-approved supplier list

a. ESC Automation

.5 Part 2.9.10: Add the following:

The flow switch shall be thermal dispersion type.

.6 Part 2.9.2: Replace with the following:

Provide Magnetrol Thermatel Model TD1/2 flow switch or approved equal.

.7 Add Part 2.10.4.8.7: Instantaneous Power (kW)

PART 6 ETS COMPONENTS AND ACCESSORIES (CONTRACTOR SUPPLIED)

Equipment List

As shown on D-106, D-107, D-108, D-109, D-110.

The following table shows the piping and insulation types expected for the ETS.

Table 2: Piping and Valve List

Description	Drawing #	Pipe Type	Insulation Type	Insulation Jacketing	Isolation Valve Type	Drain / Air Vent Valve Type	Pressure Relief Valve Type	Needle Valve Type	Notes
Primary Hot Water Supply	D-106-110	S01	Type 1 or 2	PVC	BV-01	BV-02	PR-01	NV-01	1, 3
Primary Hot Water Return	D-106-110	S01	Type 1 or 2	PVC	BV-01	BV-02	PR-01	NV-01	1, 3
Space Heating Supply	D-107-110	S01	Type 1 or 2	PVC	BV-01	BV-02	PR-01	NV-01	1, 3
Space Heating Return	D-107-110	S01	Type 1 or 2	PVC	BV-01	BV-02	PR-01	NV-01	1, 3
DHW Supply	D-108-109	C01 or SS01	Type 1 or 2	PVC	BV-03	BV-03	PR-02 or PR-03	NV-02	1, 2, 3
DHW Return	D-108-109	C01 or SS01	Type 1 or 2	PVC	BV-03	BV-03	PR-02 or PR-03	NV-02	1, 2, 3

Notes:
1. Description of material and component types as described throughout the specification.
2. Select pipe type to match building piping material.
3. All valves/instrumentation must satisfy operating conditions shown on P&ID drawings.

END OF SECTION

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PART 1 GENERAL

1.1 General Requirements

.1 Provide a complete project incorporating the specified materials and first class workmanship.

.2 Complete the work during the specified working period.

1.2 Document Conflict

.1 Figured dimensions on a drawing take precedence over measurements scaled from the drawing, and large-scale drawings take precedence over those of smaller scale. Supplementary drawings and specifications supersede their antecedents. In case of conflict between figured dimensions on a drawing and the dimensions of a specified product, the dimensions of the specified product will govern. The drawings and specifications complement each other and anything called for by one will be as binding as if called for by both.

1.3 Standard Specifications

.1 The edition current on the date of advertisement for tenders for this contract will be deemed to be in effect.

.2 The reference standard specifications and documents shall be considered to be a part of these specifications insofar as they apply.

.3 The National Building Code of Canada and all applicable local and Provincial Building Codes shall govern all materials, methods, workmanship and conditions not explicitly detailed in contract drawings and specifications.

.4 The current edition of the Canadian Electrical Code shall govern all electrical work.

1.4 Co-operation

.1 Co-operate to fullest extent with representatives of the Owner, the various utility companies, private citizens adjacent to whose property the work is being conducted, and other contractors working in the facility.

.2 Direct all communications through the Contract Administrator. Provide the Contract Administrator with a minimum of forty-eight (48) hours notice prior to moving onto site. Provide the Contract Administrator with a minimum of twenty-four (24) hours notice prior to leaving site. Attend site meetings as required by the Contract Administrator.

.3 The Contractor shall contact the Engineer immediately if a discrepancy is found between drawings and actual field conditions.

1.5 Drawings for Construction

.1 The Owner will provide scaled electronic versions of the drawings and specifications to the Contractor for construction.

1.6 Information to Subcontractors and Suppliers

.1 The Contractor shall supply complete information to sub-contractors and equipment and material suppliers. Where both specifications and drawings are required to provide complete information on any aspect of the work, the Contractor shall supply both to the sub-contractor and/or supplier concerned.

1.7 Equal and Alternate Equipment and Materials

.1 Equipment or materials other than those specified may be approved by the Contract Administrator. Refer to the Summary of Work.

1.8 Layout

.1 The Contractor shall be responsible for all layout of the work in accordance with the drawings, including calculation of layout dimensions and elevations.

.2 Elevations shown on the drawings are in metres to geodetic datum.

.3 The Contractor shall take all necessary precautions to preserve existing benchmarks or legal survey pins on and adjacent to the site. Two days notice shall be provided to the Owner in the event that a benchmark or pin must be disturbed during the course of construction. If the Contractor fails to comply with this requirement he will be charged with the expense of replacing the disturbed legal marker by a registered B.C. Land Surveyor.

.4 The Contract Administrator will establish elevation and layout control for the work. The survey information that will be provided by the Contract Administrator will generally be as follows:

1.9 Locating and Protecting Existing Utilities

.1 Depths and location of existing utilities shown on drawings are for guidance only based on available record drawings. Completeness and accuracy are not guaranteed.

.2 The Contractor shall be responsible for all costs associated with repair of existing services that are damaged during construction.

1.10 Protection of Structures

.1 Provide adequate shoring and erosion protection to prevent undermining of any existing structures and services.

.2 Submit proposed shoring techniques to the Contract Administrator for approval prior to excavation (Refer to the shoring requirements in Division 2).

1.11 Legal Survey Markers

.1 Contractor and Contract Administrator will inspect site and record on a plan all existing legal survey markers to be protected. Where work cannot be completed without damaging or dislocating a marker, notify Contract Administrator before disturbing marker. Replace at Contractor's expense all such markers, disturbed or removed.

1.12 Emergency Crews

.1 Before commencement of construction, provide to the Owner a list of at least 3 names and telephone numbers of the Contractor's representatives who can be called outside normal working hours to act for the Contractor for emergency “call outs” in connection with work under the Contract. At least one person on the list shall be available at all times outside of normal working hours.

1.13 Notice to Utility Owners and Users

.1 When work is to be conducted in the vicinity of gas lines, water mains, sewers, telephone and hydro lines, or other aboveground or underground structures, notify utilities at least seventy-two (72) hours in advance.

.2 Obtain utility's permission in writing prior to interrupting any service. Distribute notices to all premises affected by the interruption twenty-four (24) hours in advance of service interruption.

.3 In emergency situations, where life or property is endangered, take whatever action is necessary to eliminate danger and minimize damage.

1.14 Permits, Easements and Working Space

.1 The Contractor shall furnish labour and facilities to:

.1 Provide access to work to be inspected and tested;

.2 Facilitate inspections and tests; and

.3 Make good any work disturbed by inspections and tests.

.2 In addition the Contractor shall notify the Owner 48 hours in advance of operations to allow for assignment of personnel and scheduling of tests, and the Contractor shall pay all costs for uncovering and making good any work that is covered, before required inspection or testing is completed and approved by the Contract Administrator.

.3 The Contractor shall comply with all municipal and governmental regulations governing construction.

.4 The Contractor shall ensure that the Contractor and all subcontractors obtain and pay for all necessary permits, fees, licences, certificates of inspection, and insurance in connection with the works as may be required under this contract any applicable federal, provincial and municipal regulations or bylaws.

.5 The Contractor shall assume that the Owner has complied with statutory requirements of all legally constituted agencies from whom permissions are required or to whom notices must be given to do the work.

1.15 Material Storage

.1 Store all material purchased for Contract in safe and secure storage area in accordance with manufacturer's recommendations.

1.16 Disposal of Waste Materials

.1 All waste materials, including native materials from excavations that are deemed by the Contract Administrator to be unsuitable for re-use, remaining debris from clearing, existing structures, remains of previous land uses, or any debris or rubbish encountered on the site are to be removed from the site and disposed of at locations obtained by the Contractor.

.2 The cost for removal and disposal off site of all waste materials shall be included in the tender prices.

.3 Disposal of waste or volatile materials, such as mineral spirits, oil or paint thinner into sewers or waterways is prohibited.

1.17 Site Maintenance and Cleanup

.1 The working area shall be maintained in an orderly manner and shall not be encumbered with equipment, materials, or debris.

.2 Cleanup shall be a continuing process from the start of the work to final acceptance of the project. The Contractor shall at all times keep the work site free from accumulations of waste materials or rubbish caused by employees or by the work. Accumulations of waste materials that might constitute a fire hazard will not be permitted. Spillage from the Contractor's hauling vehicles on travelled public or private roads shall be promptly cleaned up. On completion of construction, the Contractor shall remove all temporary structures, rubbish, and waste materials resulting from his operation.

1.18 Final Cleanup

.1 In addition to the progressive removal of rubbish from buildings, structures and site, and leaving the buildings broom clean, perform the following work before acceptance.

- .1 Clean all glass, and replace broken glass.
- .2 Remove stains, spots, marks and dirt from all finished work, electrical and mechanical fixtures, furniture, etc.
- .3 Clean hardware.
- .4 Remove paint spots and smears from all surfaces.
- .5 Vacuum clean all building interiors affected in construction operations.
- .6 Make a thorough inspection of all finishes, and equipment to make sure of proper workmanship and operation.
- .7 Ensure two coats of wax are applied to resilient floor surfaces.
- .8 Broom clean exterior walks, steps and platform and remove dust, dirt and other disfigurements from exterior surfaces.

.2 Remove all temporary work from the site including but not limited to fencing, sign board, samples, and any other items not considered to be part of the permanent works.

.3 After successful completion of leakage tests, clean debris and foreign matter from the structures.

1.19 Access and Public Safety

.1 The Contractor shall effectively warn and protect the public from any danger as a result of the work.

.2 No material or equipment shall be stored where it will interfere with the free and safe passage of public vehicular or pedestrian traffic (except within the defined working area) or in such a manner that it creates a hazard to the public.

.3 The Contractor shall at all times ensure that fire hydrants are not obstructed and are thus readily accessible to the Fire Department.

.4 The Contractor shall also ensure that there is unobstructed access for the Owner to the existing facility.

1.20 Safety Procedures

.1 The Contractor shall at all times employ safety procedures required by WorkSafe BC and the Owner.

1.21 Warranty

.1 Note any special warranty items noted in specific sections.

.2 If the Contractor fails to take action within ten (10) days of the date of notice, then the Owner reserves the right to make the repairs itself and with the cost billed to the Contractor.

.3 In the event of an emergency situation where time is of the essence, the Owner may make repairs without notice being sent to the Contractor. The cost of such repairs will be billed to the Contractor.

1.22 Open Site Designation

.1 Tenderers are advised that the Owner may be awarding two or more contracts for work to be done simultaneously on the same construction site.

.2 As the construction site is open to both union and non-union contractors, the successful tenderer should be aware that his personnel are expected to operate alongside all other workers irrespective of their labour affiliation.

END OF SECTION

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PART 1 GENERAL

1.1 Insurances and Bonds

.1 Promptly submit Bond and Insurance Certificates as required to the Owner. Progress draws will not be paid before these documents have been submitted. Insurance Certificates shall name the Owner as additional insured.

.2 All submittals required to be submitted within 15 days of award of contract.

1.2 Schedule

.1 Refer also to Section 01110 Summary of Work – Schedule.

.2 A schedule is required for this project. The Contractor shall prepare the schedule as follows:

.1 After award of contract and before commencement of the Work, a first project meeting will be held with the Owner, Consultant, Contractor, and Subcontractors in attendance. The Contractor shall prepare a preliminary and proposed sequence of work, for presentation at this meeting. Timing of service interruptions, phases and sequence of the Work, etc., and any clarifications with respect to scheduling will be brought forward and discussed at this time.

.2 Following this meeting the Contractor shall submit his schedule, to include required staging and sequencing of the Work and also detailed scheduling for mechanical, plumbing and electrical work, etc., to the Owner for final acceptance. The schedule shall include any instructions resulting from the first project meeting. This shall be submitted within one week of the project kickoff meeting described in Part 1.2.2.1.

.3 In order to improve the work schedule or eliminate unforeseen problems, modifications to the schedule may be suggested by the Owner, Consultant or the Contractor during the contract and such modifications may be implemented by mutual agreement. Schedules must be updated and reissued monthly to reflect the agreed changes.

.4 The contractor shall submit monthly project schedule updates, both in hard copy and electronic form. The schedule shall detail task start, duration, and completion dates, and percent complete of each task. It shall highlight critical tasks, task linkages, and order/delivery dates for major equipment components. An up-to-date schedule submitted both in print and electronically, is required with all progress claims.

.3 The Contractor shall note the Sequence of Construction considerations in Section 01110 in preparing his schedule.

.4 If, in the opinion of the Owner, any submitted construction program is inadequate to ensure completion of work within time limited, or is otherwise not in accordance with the specifications, or if the work is not being adequately or properly prosecuted in any respect, the Owner, without derogating from the Owner's right under this agreement, shall have the right to require the Contractor to submit a new

construction program providing for proper and timely completion of the work; the Contractor shall be entitled to no claim for extension of time on account of such requirement.

1.3 Progress Reports/Daily Reports

.1 The Contractor shall, from the date of commencement of the Work, maintain a careful daily record of the progress of the Work. This record shall be open to inspection by the Consultant or the Owner at all reasonable times and shall, if requested, be turned over to the Consultant at Substantial Performance of the Work. The record shall show all pertinent data such as:

.1 Commencement, progress and completion of various portions of the work, including photos.

.2 Dates of all meetings and their purpose,

.3 Dates of visits by government authorities, inspectors, utility companies and the like,

.4 Record of work force employed,

.5 Materials causing delay,

.6 Clarifications or questions, and

.7 Safety program records.

.2 The contractor shall maintain an accurate daily diary as the work progresses. Record personnel and equipment on site, deliveries of materials, progress, problems encountered, weather conditions, and other pertinent information. Diary shall be open to the Contract Administrator at all times. Turn over an exact copy of diary to Contract Administrator upon completion of contract.

1.4 Weekly Reporting Requirement

.1 The Contractor shall submit a weekly report to the Owner and Consultant highlighting the following information:

.1 Work completed;

.2 Updated schedule for the following two weeks;

.3 Known issues on site; and

.4 Any deviations anticipated from the drawings.

1.5 Shop Drawings, Samples and Product Data

.1 All Shop Drawings and Samples are to be submitted to the Consultant and the Owner for review.

.2 Unless specifically requested Samples need not be submitted to the Owner. Product data is not normally required to be submitted to the Owner. The exception to this is the Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.

1.6 Inspection and Test Reports

.1 Testing Reports shall be submitted to the Contractor with copies to the Consultant.

.1 X-ray reports shall be provided as received and films shall be included in the O&M manual.

1.7 Reviewed Shop Drawings

.1 One complete set of reviewed Shop Drawings is to be kept at the work site for reference by Consultants and Inspectors.

1.8 Submittal Format

.1 All submission to the Consultant shall be electronic in pdf format.

.2 All Record drawings shall be submitted in CAD (*.dwg) and pdf.

.3 Shop drawings should be numbered and clearly labeled to identify where the selected component will be used.

.4 All submittals must contain a compliance statement, which highlights any deviations from the specification. Where a product sheet is provided with multiple options, the selected option(s) must be clearly identified.

.5 Shop drawings shall at least show methods of construction, principal dimensions, materials, material specifications, welded joints, coatings and finishes and total net assembled weight of each fabricated piece of work or each item of equipment. Provide complete electrical data where applicable. Provide drawings sealed by Professional Engineer where applicable.

.6 Review of shop drawings will be to assess their compatibility with the general design concept only. This review will not relieve the contractor of his responsibility for accuracy of the detail dimensions, general fit-up of parts to be assembled, adequacy of connection details, errors or defects contained in the details, or for safety and adequacy of erection methods proposed. Such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents.

.7 The Contractor is responsible for quantities and dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all subtrades.

.8 The Engineer reserves the right to require the Contractor to make any changes in the Contractor's drawings and/or his specifications which may be necessary, in the opinion of the Engineer, to make the finished product conform to the requirements and intent of these specifications.

.9 If requested by the Contract Administrator, prints of corrected shop drawings shall be resubmitted in the same manner as above.

.10 Any manufacturing completed prior to the reviewed shop drawings being returned will be at the Contractor's risk.

.11 Additional requirements may be noted in specific sections of these specifications.

1.9 Equal and Alternate Equipment

.1 Equipment, other than that specified, of equal quality, will be allowed. Acceptable equipment shall be reviewed and approved by the Engineer five working days prior to the closing of tenders, if submitted ten working days prior to the closing of tenders for review.

.2 Should the Contractor propose to substitute equipment having different dimensions or requiring connections or piping layout at variance with the drawing, it shall be the Contractor's responsibility to submit a detailed drawing showing how proposed substitute equipment is to be installed and connected in the available space. Any proposed variations from contract drawings shall be specifically indicated.

.3 Where two or more items of equipment or materials of similar design are to be installed, they shall be the products of one manufacturer.

.4 Equipment, other than that specified, which has been approved by the Engineer as “equal” 5 days prior to the closing of tenders may be substituted at the Contractor's discretion provided aforementioned conditions are met.

.5 Equipment, other than that specified, which may be approved by the Engineer as an “alternate” following the closing of tenders, may be substituted by the Contractor at the discretion of the Engineer provided suitable adjustment of contract price is negotiated.

.6 Equipment, other than that specified, which has been installed but not approved by the Engineer, may be rejected. In this case the equipment shall be removed, and approved equipment installed, at the Contractor's expense.

.7 The Contractor shall be responsible for all expenses incurred in the work of other trades made necessary because of substitution.

1.10 Tender Submittals

.1 Compliance Form.

.2 Form of Tender.

.3 Schedule.

1.11 Post-Award Submittals

.1 Provide submittals for the equipment listed in Table 1.9.1

.2 Where equipment is not listed in the table, immediately notify the Consultant for addition of the equipment to the list. Provide submittals for the omitted equipment in accordance with the project specifications.

.3 The Contractor shall also provide submittals as requested in the submittals sections of the standard specifications.

Table 1.9.1

GENERAL

Schedule
Quality Control Manual
Licenses/Insurance/WCB Clearance Letter
List of Recommended Spare Parts
ETS Layout(s)
EQUIPMENT
Heat Exchangers
PIPING
Sample Mill Certificate
Gasket(s)
Strainer(s)
Seismic Restraints
Insulation & Jacketing
Hangers & Supports
Pipe conditioning & Chemicals
Welders Qualifications
Weld Inspection Company Certificate
Welding Procedures
Hydrostatic Testing Procedure
Flushing Plan
Temperature & Pressure Gauges & Thermowells
VALVES & FITTINGS
Ball Valve Type BV-01
Ball Valve Type BV-02
Ball Valve Type BV-03
Needle Valve Type NV-01
Needle Valve Type NV-02
Pressure Relief Valve Type PR-01
Pressure Relief Valve Type PR-03
CONTROLS
Controls configuration & design
Programmable Logic Controller
Control Panel
Control Valve (s)
Differential pressure transmitter(s)
Pressure transmitter(s)
Temperature sensor(s)
Flow meter(s)
Field instrument(s)

Energy meter (s)
Moisture Detector
Flow Switch
Current Sensor

1.12 Project Closeout Submittals

.1 Provide submittals for the equipment listed in Table 1.9.1.

.2 Where equipment is not listed in the table, immediately notify the Consultant for addition of the equipment to the list. Provide submittals for the omitted equipment in accordance with the project specifications.

Table 1.9.1

GENERAL
Operation and Maintenance Manuals
Weld Maps
Red Line Drawings
Isometrics

1.13 "As Constructed" Information

.1 It shall be the responsibility of the Contractor to maintain one set of white prints updated to show all changes incorporated into the Work. The prints shall be available for inspection by the Contract Administrator at all times during progress of the Work.

.2 These drawings will contain the following information:

.1 All dimensions shown on the design drawings shall be checked as-built or if changed the as-built dimension shall be written in RED in the appropriate locations.

.2 Actual equipment installed (replace "or equal," "or equivalent" by Model number and Manufacturer).

.3 Precise location of piping including tie-in points.

.4 Dimensions of all structures including elevations.

.5 Description, elevation and location of other services encountered during construction.

.3 Submit to the Owner two complete marked up sets of prints showing all as-constructed changes, including changes directed by the Contract Administrator, to the contract drawings at minimum once each year, and within 7 days of completion of the work.

1.14 Operation and Maintenance (O&M) Manuals

.1 Where specific O & M manual requirements are included in the subsequent sections of this specification, they shall take precedence over the requirements of this section.

.2 The Contractor shall furnish two (2) hard copies and one (1) soft copy of a complete instruction manual for installation, operation, maintenance, and lubrication requirements for each component of structural, mechanical and electrical equipment or systems.

.3 O & M manuals shall be organized in a clear and logical format and include the following information:

.1 A list identifying the General Contractor, subcontractors, the consultant, subconsultants, and suppliers (include addresses, phone numbers, and FAX numbers).

.2 Material Test Reports.

.3 Warranties.

.4 Equipment Schedule showing service, unit number, location, make, model and supplier.

.5 Instruction and Service Manuals.

.6 List of spare parts.

.7 Preventative Maintenance Schedules.

.8 Performance Bonds

.9 Red line drawings including survey shots.

.10 Isometrics.

.11 Electrical connection drawings and controls schematic.

.12 Approved shop drawings.

.13 Weld Maps.

.14 Test Reports including but not limited to: weld X-ray, visual weld inspection, flushing, hydrostatic test, chemical cleaning, flushing, commissioning and calibration certificates.

1.15 Instruction and Service Manuals

.1 Provide one (1) hard copy and one (1) soft copy of instruction and service manuals c/w spare parts lists for all of the equipment supplied by the contractor, including but not limited to the following:

.1 Heat Exchangers.

.2 Control valves.

.3 Manual Valves.

.4 All other mechanical systems.

.2 Coordinate and bind with manuals provided by electrical subcontractor.

.3 Manuals are to be plastic coated catalogue binders with hot stamp lettering front and spine.

.4 Manuals shall contain at least the following:

.1 Title page.

.2 Table of contents.

.3 Drawings and manufacturers' specifications for each specific item of equipment supplied including model numbers and serial numbers.

.4 Maintenance and operating instructions where applicable.

.5 Electrical connection drawings and control schematic for applicable equipment.

.6 Provide space for literature for Owner-Supplied Equipment. (Requirements to be supplied by the Engineer.)

END OF SECTION

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PART 1 GENERAL

1.1 Scope of Work

.1 This section covers work related to temporary construction facilities and controls.

1.2 Sanitary Rules and Protection of Environment

.1 To be coordinated with building contractor.

.2 Maintain all portions of work in a neat, clean and sanitary condition at all times. Leave all work sites in neat condition at end of each working day.

.3 Provide sanitary conveniences for use of persons engaged in the work and strictly enforce their use.

.4 Latrine facilities shall be located and maintained in such a manner that they are not offensive to any property owner or member of the public. Facilities shall meet with the requirements of the Health Inspector.

.5 No trespass of areas outside designated work areas will be allowed.

.6 All waste materials shall be removed from the site and disposed of by the Contractor.

.7 Water pumped from the site must flow through a sump for settlement of solids before being released into any waterways.

.8 Comply with environmental requirements of the provincial and local authorities.

.9 Control the generation of dust.

1.3 Contractor's Office

.1 The Contractor shall, within five (5) days after receipt of notification of acceptance of his tender, advise the Owner in writing of one local address at which he wishes to receive all correspondence from the Owner.

1.4 Contractor's Plant and Utilities

.1 The Contractor shall be responsible for the supply, erection, maintenance and removal of whatever buildings or appurtenances he requires to perform the work, and shall obtain any necessary permits.

.2 The Contractor shall be responsible for the supply, maintenance and removal of whatever electric, telephone, water or sanitary facilities he requires for his plant for either domestic or construction purposes.

.3 The Contractor shall provide water for testing where the Contract Administrator considers that there may be a risk of contamination of the water system. Otherwise, subject to approval of the Owner, the municipal water supply may be used.

1.5 Power and Water for Construction and Testing

.1 The Contractor shall make all arrangements and pay for all costs connected with the supply of power and water for construction and testing. Power is not available at the site. The Contractor may make arrangements with individual property owners for power and water.

.2 Contractor shall make all arrangements and pay any costs associated with the disposal of water during construction and testing (i.e. during flushing).

1.6 Security

.1 The Contractor shall be responsible for the security of all sites and materials during the course of the work to the satisfaction of the Contract Administrator.

.2 The Contractor shall provide adequate barricades and lighting around and adjacent to any open excavation or other potentially dangerous location and of other locations specifically designated by the Owner.

END OF SECTION

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PART 1 GENERAL

1.1 General

.1 The Contract Administrator will issue Substantial Performance for the Contract or subcontracts within 10 days of a request by the Contractor, provision of supporting scope and financial information (relative to subcontracts) and at such time as the work is substantially complete as defined by the Builders Lien Act.

.2 This will then enable the 55-day holdback period to commence for the 10% of the Contract Price that must be withheld by the Owner in accordance with the Builders Lien Act.

.3 A deficiency holdback, in addition to the 10 percent holdback for Builders Liens, may be retained to cover the costs of any incomplete items. The deficiency holdback may be based on twice the value of the uncompleted work as determined by the Contract Administrator.

1.2 Final Inspection and Deficiency List

.1 Prior to requesting substantial completion, the Contractor must request a final inspection by the Consultant. The Consultant will compile and issue a Deficiency List.

.2 It is the responsibility of the Contractor to complete each deficiency, and provide the Consultant with appropriate documentation including photographs and sign-off.

1.3 Final Completion of the Work

.1 The Contract Administrator will issue a Final Certificate for Payment upon completion of the entire work, including deficiencies, to the satisfaction of the Contract Administrator.

1.4 Payment of Holdback Upon Substantial Performance of the Work

.1 Payment of the holdback (other than deficiency holdback) for the Contract or Subcontracts will be made in accordance with the B.C. Builders Lien Act and after the following are complete:

.1 Expiry of the holdback period.

.2 Submission by the Contractor (or Subcontractor) to the Owner of a Statutory Declaration that all accounts have been paid by the Contractor and that no liens exist in regard to work under this contract.

.3 Submission by the Contractor to the Owner of a statement from Workers' Compensation Board that all accounts are paid in full.

1.5 Final Payment Upon Completion of the Work

.1 The final payment (including deficiency holdback) will be made after issuance of the Final Certificate for Payment.

.2 Partial deficiency holdback release is at the sole discretion of the Owner

END OF SECTION

Standard Specification Revision History:

Rev. No.	Date	By	Chk'd	Comment
0	05/05/2016	MDM	NS	
1	05/03/2018	MSS	RJM	2.3, 3.3.2, 3.4.2, 3.10.3, 3.10.6 & 3.11.1

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PART 1 GENERAL

1.1 Scope of Work

.1 Construction of reinforced and unreinforced concrete structures, including:

.1 Equipment pads;

.2 Floatation pads;

.3 Slabs-on-grade; and,

.4 Post footings.

.1 This section shall also cover work for:

.1 Formwork;

.2 Reinforcing; and,

.3 Supply, placement, and finishing of concrete.

1.2 Related Work

.1 Read this Section in conjunction with other Sections of the Specifications and the General Requirements.

.1 Precast Concrete Specialties Section 03480

.2 Construct concrete curbs according to local municipal Standard Construction Drawings and Specifications where existing curbs are damaged by construction of this project.

1.3 References

.1	CSA-A23.1	Concrete Materials and Methods of Concrete Construction
.2	CSA S269.1	Falsework for Construction Purposes
	CAN/CSA-S269.3	Concrete Formwork

1.4 General Requirements

.1 Design and construct all formwork and falsework in accordance with CSA S269, except for additional requirements specified by WorkSafe BC.

.2 Concrete shall be supplied in accordance with the requirements of CSA CAN 3-A23.1/A23.2.

.3 Concrete shall not be placed in any part of the work until the part has been inspected and approved by the Engineer as ready for concreting.

1.5 Submittals

.1 Submit proposed concrete mix designs to the Engineer for review at least one week prior to the first concrete pour.

.2 Do not proceed with concrete work until Engineer has approved the above submittal.

PART 2 PRODUCTS

2.1 General

.1 Where not specified, all product shall be new, best quality and approved by the Engineer.

.2 All products shall be handled and stored to ensure preservation of quality and fitness for the work. Materials shall be stored under cover when required by the Engineer.

2.2 Form Materials

.1 Class I – New, waterproof, synthetic resin-bonded plywood specially made for concrete work, constructed with particular care to ensure high type of architectural form of uniform texture, free from irregularities, patch marks and discolouration.

.1 Use for all permanently exposed concrete surfaces.

.2 Class II – Plywood in good condition, free from large, loose knots; use for formed surfaces not exposed to view, such as footings and backfilled walls.

2.3 Form Ties

.1 Plastic cone-type snap ties. Snap-tie break-off point shall be a minimum of 40 mm back from the concrete surface.

2.4 Joint Filler

.1 12 mm thick closed cell polystyrene foam.

2.5 Sleeves for Wall Penetrations

.1 Sleeves shall be provided as directed by the Engineer prior to casting of concrete.

.2 Provide Engineer with at least 5 days' notice of wall pours so that locations of sleeves can be determined.

.3 Standard of acceptance: as specified on the drawings.

2.6 Form Oil

.1 K - 790 Krystol Breakaway or approved equivalent.

2.7 Reinforcing Steel

.1 New stock, Grade 400R (or 400W for weldable applications), deformed steel bars conforming to CSA G30.18M, with F_y = 400 MPa.

.2 Welded wire mesh to CSA specification G30.5M for welded steel wire fabric for concrete reinforcement.

2.8 Reinforcing Supports

.1 For tying reinforcement; black annealed wire not less than 1.6 mm diameter.

.2 For suspended slabs; support by hangers, plastic chairs, or steel chairs not less than 6 mm diameter with galvanized or plastic coated legs.

.3 For slabs on grade; support by concrete chairs of the same or higher strength as the cast concrete.

2.9 Concrete

.1 Cement to CSA-3001-08 GU.

.2 Aggregate conforming to CSA A23.1, normal density, properly screened - size 5 to 20 mm, or as otherwise specified.

.3 Free from alkali, organic matter, or other deleterious substances, and not containing silt, friable, thin, flaky, elongated or laminated particles.

.4 Air-entraining admixture conforming to CAN 3-A266.1-M.

.5 No other admixtures shall be used without approval of the Engineer.

.6 Admixtures shall not contain calcium chloride.

.7 Mix Water: Potable water clean and free of oils, acids, alkali and organic materials.

2.10 Accessories

.1 Concrete Curing Compound

.1 To ASTM C.309 Specifications for Liquid Membrane-Forming Curing Compound for Concrete.

.2 “MASTERKURE” CC-200WB as manufactured by BASF Master Builders Ltd. or approved equal.

.2 Damp Proofing Material

.1 To the requirements of CAN/CGSB 37.2-M.

.2 A mineral colloid asphalt emulsion, unfibrated, of medium consistency, suitable for application by brushing or spraying.

.3 Apply to the requirements of CAN/CGSB 37.3-M.

.3 Bonding Agent

.1 Darweld C or approved equal as supplied by Grace Construction Products, or

.2 Polymer Bonding Agent as manufactured by Target as supplied by Universal.

.3 Krystolbond as manufactured by Kryton International Inc.

.4 Concrete Water Proofing Material

.1 Provide waterproofing where shown and as described on the drawings.

.5 Joint Sealant

.1 Apply where shown on drawings.

.2 Sikaflex 1a, one component, polyurethane sealant, except where otherwise indicated.

.3 Poly sulphide base, 2 component, colour to match concrete.

.4 Apply in accordance with Manufacturer's recommendations complete with recommended joint sealer and primer.

.6 Cork Cell Joint

.1 To ASTM C.1752 - 67T Type II where specified or shown on drawings.

2.11 Grouts

.1 Standard Grout

.1 Composed of Type GU Portland cement, fine aggregate, and water.

.2 Fine aggregate conforming to CSA CAN 3-A.23.1/A23.2, except graded so that 100% by weight passing a standard 2.36 mm sieve, and at least 45% by weight passing a standard 0.425 mm sieve.

.3 Mixture consisting of one part cement, two parts sand, and a consistency suiting the application.

.4 Used as soon as possible after mixing; any grout mixture too stiff for use shall be wasted (i.e. retempering with water will not be permitted).

.2 Waterproof Snap-Tie Grout

.1 Vandex, Xypex or Kryton premix snap-tie grout mixed in mortar consistency, or

.2 Krystol Bari-Cote as manufactured by Kryton International Inc.

.3 Non-Shrink Grout

.1 Non-Metallic Premixed cementitious grout (fluid consistency) free of gas producing agents, attaining a compressive strength of 21 MPa at 3 days, 45 MPa at 28 days.

.2 Masterflow 713 non-shrink grout by Master Builders or approved equal.

.4 Non-Shrink Mortar

.1 Single component, premixed, polymer modified fast setting repair mortar.

.2 Integral corrosion inhibitor.

.3 Meets Class C1 exposure classification (CSA A23.1 current edition).

.4 Compressive strength of 24 MPa at 7 days and 34 MPa at 28 days.

.5 28 day shrinkage: < 0.040% at 23C ±2C, 50% R.H.

.6 Standard of Acceptance: Target V/O structural repair mortar or as specified on the drawings.

2.12 Concrete Mixes

.1 Composition

.1 Portland cement, water, natural aggregates, and admixtures.

.2 Proportioned and mixed as specified to produce a strong, dense, impermeable concrete with specified strengths and consistencies.

.2 Mix Types

.1 Types of concrete applicable to designated areas, unless otherwise indicated on the drawings, conforming to following table.

Type	Description	28 Day Comp. Strength (MPa)	Max. Aggr. Size (mm)	Max. Slump (mm)	Exposure Class	Max. WC Ratio	Air Content (%)
A	All structural concrete	32	20	80	C1	.40	5.5
B	Plain concrete for thrust blocks, skim coats under footings, mass concrete, encasement, caps etc.	30	38(2)	80 (1)	C3	.5	-
C	Controlled Density Fill	0.5		Refer to MMCD Section 31 23 23			
	Tolerances	-	-	+/- 20	-	-	+/-1.5
	Notes: (1) Lower slump may be required for secondary concrete and benching. (2) Maximum aggregate size for skim coats shall be 20 mm.						

.2 Water cement ratio is expected to control cement content.

.3 Properties shall be determined in accordance with CSA CAN 3-A23.1/A23.2.

.3 Mix Designs

.1 Submit proposed mix designs to Engineer for approval.

.2 At the discretion of the Engineer, the Contractor may be required to supply test cylinder results to confirm mix design for each strength; testing shall be in accordance with CSA CAN.3-A23.1/A23.2.

PART 3 EXECUTION

3.1 Installing Form Work

.1 Supply, erect and maintain all forms to confine concrete within neat lines shown on drawings. Provide 20 mm chamfer on all exposed corners.

.2 Forms shall be so constructed that finished concrete surfaces shall be of uniform texture.

.3 Install all embedded metal work and piping though concrete as specified or shown on the drawings. Coordinate with Mechanical and Electrical trades.

3.2 Formwork Construction Details

.1 Chamfers

.1 Form chamfers approximately 20 mm x 20 mm at all exposed concrete edges and corners.

.2 Openings

.1 Provide openings in forms to permit inspection and cleaning, placing and compaction of concrete, and forming and processing of construction joints.

.3 Ties

.1 Where embedded rods, snap-ties or other similar devices are used for holding forms, they shall remain embedded and shall terminate at least 40 mm back from formed face of the concrete, leaving holes of regular shape for reaming.

.2 Fill holes in accordance with repair method described herein.

.3 Twisted wire ties are not acceptable.

.4 Wooden spreaders, if used, shall not deface or deform the formwork. Spreaders shall be removed as concreting operations proceed.

.5 Install cone type snap-ties in regular pattern and level rows.

.4 Form Surfaces

.1 At time concrete is placed in forms, surfaces of forms shall be free from encrustations of mortar, grout, or other foreign matter.

.2 Remove all dirt, chips, sawdust and other foreign matter from within forms before any concrete is deposited therein.

.3 Oil surface of forms with commercial form oil that will effectively prevent sticking and will not stain concrete surfaces before concrete is placed.

.5 Final Alignment Check

.1 Immediately before concrete is placed, take precautions to see that all forms are in proper alignment, are mortar-tight, reinforcement clearances are correct, and that all form supports are secure and tight.

.6 Tolerances for Forms and Screeds

.1 Tolerances shall be within the following limits except where otherwise noted on the drawings. Tolerances shall also conform to Section 10 of CSA-A23.1 except that where the drawings and specifications are stricter than the Standard, the former shall govern.

Location	Tolerances
Footings, alignment of outside face, top elevation, and thickness.	+/- 6 mm, and not more than 5 mm variation in 2.4 metres when tested with a straight edge.
Slabs on Grade Thickness Top Elevation	 - 0 mm, + 25 mm +/- 3 mm, not more than 6 mm variation in 2.4 metres when tested with a straight edge.

.2 Tolerances shall apply to true grade which shall include chamfer shown on drawings prior to removal of forms.

.7 Slab Drainage

.1 Construct all slabs with positive drainage.
.2 Construct all building floor slabs with floor drains where required.
.3 Maintain specified floor or slab elevation at all perimeter walls, and slope floor uniformly to drain to sump, as indicated on drawings.

3.3 Removal of Forms

.1 Schedule

.1 Leave forms in place until removal authorized by the Engineer.

.2 Remove as soon as practicable thereafter in order to avoid delay in curing and to enable earliest possible repair of surface imperfections.

.3 Consent of Engineer for removal of forms in no way relieves Contractor of obligations to delay removal of forms until concrete has cured to sufficient strength.

.4 In no case shall removal of forms commence earlier than the following:

Item	Earliest Time
sides of footings	24 hours

.5 In cold weather (when temperature drops below 10ºC), time limits for removal of forms may be extended as required by the Engineer.

.2 Care of Concrete

.1 Remove forms with care so as to avoid damage to concrete.

.2 Make good to satisfaction of Owner any damage arising from removal of forms.

3.4 Placing Reinforcing Steel

.1 Bending of Steel

.1 Cut and cold bend bars accurately to required sizes and shapes in accordance with CSA A23.1.

.2 Bending or straightening which will damage reinforcing steel will not be permitted.

.2 Cleaning

.1 Before being positioned, clean reinforcing steel thoroughly of all scale, loose dirt, grease or other objectionable matter that might reduce bond with concrete.

.2 Where there is delay in depositing concrete, re-inspect and, when necessary, reclean.

.3 Placing

.1 Position accurately and secure against displacement by tying with annealed iron wire or fixing with suitable wire clips at alternate intersections.

.2 Support bottom bars in footings and slabs on concrete blocks, reinforcing steel chairs or approved PVC chairs. Support top bars on reinforcing steel spacers bearing on the bottom bars.

.3 In addition to support shown on the approved placing drawings, provide sufficient extra bar supports for additional support where in opinion of the Contract Administrator specified clearances are not being maintained.

.4 Splices

.1 Splices are not permitted except where shown on drawings or approved by the Engineer.

.2 Place spliced ends of bars so that same effective depth is maintained in concrete.

.3 Welded splices will not be permitted.

.5 Tolerances

.1 Place accurately to maintain clear cover shown on drawings.

.2 Tolerances shall be in accordance with CSA A23.1, Clause 12.8.

3.5 Batching, Mixing and Delivery of Concrete

.1 Concrete shall be mixed, transported and delivered in accordance with the requirements of CSA CAN 3-A23.1/A23.2, Section 18.

.2 Concrete shall be discharged into forms within 1.5 hours of batching.

3.6 Anchor Bolts and Inserts

.1 Inserts and anchor bolts of sizes shown, or as may be required, shall be accurately set at positions designated and securely held in position by means of wooden templates and wire ties so as to prevent shifting and floating of any metal sleeves during concrete placing operations.

.2 Anchor bolts shall be set before concrete placement and shall not be inserted into placed concrete, unless indicated in the drawings otherwise or as agreed with the Engineer.

3.7 Construction Joints

.1 Locate construction joints as shown on drawings or as approved by the Engineer.

.2 Place concrete in each unit of construction continuously.

.3 Where the placing of concrete is suspended, take necessary precautions for joining future work before the placed concrete takes its initial set to maintain a proper bond between old and new concrete.

.4 Before depositing new concrete against hardened concrete, roughen the surface by means of sandblasting, bush-hammering or mechanical scaling to the amplitude shown on the drawings. Laitance and cement paste must be removed from the entire surface and the course aggregate exposed. After roughening, clean and wet the surface thoroughly. Prior to casting new concrete, the surface must be damp but with no moisture 'sheen'. Apply bonding agent to the roughened surface just prior to pouring.

3.8 Placement of Concrete

.1 Give 24 hours' notice to the Engineer prior to placing of concrete.

.2 Do not place concrete in any part of the work until the part has been inspected and approved by the Engineer as ready for pouring.

.3 Place concrete continuously between construction joints.

.4 Place concrete in forms as nearly as practicable in final position.

.5 Do not discharge concrete in a manner which will cause segregation, such as running or working the concrete along from a central "cone" with too great a force; or so that it falls freely more than 1.5 m, unless a suitable chute or tube is used.

.6 Do not expose temporary joints for more than 45 minutes before placing adjacent concrete.

.7 All concrete shall be consolidated with the aid of suitably designed, immersion-type power vibrators.

3.9 Equipment Pads

.1 The concrete pads for equipment shall be constructed to the dimensions and details shown on the drawings. The top surface of the support pedestals shall be constructed level with a steel trowel finish. There shall be no deviations from a 3,000 mm straight edge greater than ±1.5 mm.

3.10 Concrete Quality Control

.1 Testing of Concrete Strength and Consistency

.1 The Contractor shall engage an approved third party testing agency for testing the concrete quality as described in the specifications and drawings.

.2 The testing frequency shall be as specified or as shown on the drawings.

.3 Copies of test report results shall be supplied to the Engineer up to a maximum of three days after being received from the third party testing agency.

.4 Consistency of concrete will be determined by the Contractor measuring slump of concrete in accordance with the mix type.

.5 Measured slumps shall be within the tolerances specified herein per paragraph 2.12.2.

.6 Loads of concrete which fail to meet permissible limits shall be rejected.

.2 Interpretation of Test Results

.1 Average of results of 28-day compressive strength tests performed on any one pair of cylinders shall constitute a test.

.2 Concrete from which samples taken shall be considered defective if:

.1 more than 5 percent of tests of Type A, B, or C concrete falls below specified strength

.2 two or more consecutive tests of any type of concrete fall below specified strength

.3 any single test falls below seventy percent (70%) of specified strength.

.3 Testing and Repair of Structural Defects

.1 If concrete tests fail to meet specified strength requirements, or if there is other cause to doubt ability of structure to withstand loads for which it is designed with required factor of safety, the Owner may order investigations and tests to further verify strength of concrete; tests may include testing of core drilled samples from completed structure or load testing of structure.

.2 Cores for testing shall be obtained from locations designated by the Engineer and tested in accordance with CSA-A23.2. (If results of tests clearly meet specified requirements the cost of such core sampling and testing will be borne by The Owner, otherwise cost will be charged to Contractor.)

.3 Load testing and evaluation of tests shall be carried out as described and specified in Chapter 20 of the ACI Building Code Requirements for Reinforced Concrete (ACI 318M). (If load-tested portion of structure clearly meets all test criteria, cost of load testing shall be borne by The Owner; otherwise cost of load testing shall be charged to Contractor.)

.4 The Owner may order the Contractor to carry out whatever remedial work is required to bring the structure into conformance with the specifications. All remedial work shall be at the Contractor's expense.

3.11 Protection of Concrete

.1 Protect all concrete against damage.

.2 Take all necessary measures to maintain temperatures of freshly-placed concrete at or below 23 ºC during normal curing period. Hot weather concreting shall be in accordance with CSA Standard A23.1, Chapter 19.

.3 If temperature of concrete is less than 15 ºC when air temperature is 5 ºC, or in the opinion of the Engineer, is expected to drop below 5 ºC; methods of heating concrete ingredients are subject to approval of the Engineer. For cold weather concreting, proceed in accordance with CSA-A23.1, Chapter 21.

3.12 Curing of Concrete

.1 Commence curing as soon as possible after concrete placement, stripping and finishing, and complete without causing damage to surface finish.

.2 For floor slabs:

.1 Spray apply liquid membrane curing compound immediately after finishing.

.2 Apply as per manufacturer's recommendations.

.3 Apply uniformly with complete coverage at edges and curbs.

.4 Keep traffic to minimum for seven days after application.

.5 Mix curing compound in original containers.

.3 For walls:

.1 Moisten with light spray of water immediately after forms are removed.

.2 Keep wet until concrete will not absorb more moisture.

.3 As soon as surface film of moisture disappears, but while surface still appears damp, apply liquid curing compound by spraying or brushing.

3.13 Repair of Concrete

.1 Correct all imperfections on concrete surfaces, such as pits, honeycombing and fins, which the Engineer considers objectionable from a standpoint of durability or appearance.

.2 Patching Method (Also for Cutting and Bonding to Existing Concrete)

.1 Chip out all defective concrete to depth of not less than 25 mm.

.2 Clean, brush, and soak with bonding agent.

.3 Fill with dry patching mortar composed of concrete sand, screened through a 2.36 mm sieve, and standard cement grout.

.4 Avoid colour variation in surface finishes exposed to view.

.5 Complete surface of the patch smooth and flush with surrounding concrete.

.3 Ream the holes left by removal of snap-ties or other accessories with suitable toothed reamers and, after cleaning, neatly and solidly fill with water proof snap-tie grout of colour matching surrounding concrete.

.4 Chip and grind all bulges or other projections on exposed surfaces to obtain a true, smooth surface of matching colour and texture.

3.14 Finishing and Finishes

.1 Finish various surfaces as shown or as hereinafter specified.

.2 Where finishes not clearly specified herein or shown on drawings, finish as specified for similar adjacent surfaces, as determined by the Engineer.

.3 Concrete Finish Schedule:

Location	Finish
Interior Floor Slabs	Trowelled
Interior Walls, Underside of Slabs, Beams and Columns	Repair, followed by Sack Rub
Exterior Floor Slabs	Broom finish
Exterior Walls Below Grade	Repair, followed by Water Proofing
Exterior Footings Below Grade	Repair Only
Exterior Walls Above Grade	Repair, followed by Sack Rub
Exterior Stairways and Walkways	Broom Finish

.4 Repair Finish

.1 Repair in accordance with 3.13

.5 Trowelled Finish

.1 Start steel trowelling as soon as floated surface has hardened sufficiently to prevent excess of fine material being drawn to the surface.

.2 Perform steel trowelling with firm pressure such as will flatten sandy mixture of the floated surface and produce a dense, uniform surface, free from blemishes and trowel marks.

.3 Complete steel trowelling using power trowelling machines except for areas inaccessible to machines which shall be finished with hand tools.

.6 Sack Rub Finish

.1 Concrete surface shall be sack rubbed to fill all pits and air holes.

.2 Complete sack rubbing as soon as forms have been stripped but after any required repairs have been completed.

.3 Mortar for sack rubbing shall consist of one part (by volume) cement to two parts of sand passing a 1.0 mm screen mixed with water to a creamy consistency. Vary as necessary to obtain a colour and texture to match the surrounding concrete surfaces.

.4 Sack rubbing shall be carried out in an approved manner so as to leave surfaces a uniform colour and free from mortar not used for filling voids.

.5 After sack rubbing has been completed, specified curing shall continue.

.7 Waterproofing Finish

.1 Approved waterproofing shall be applied to the locations specified in the concrete finish schedule or where described in the drawings. The application shall be to the manufacturer's recommendations as follows:

.1 Remove all form scale, laitance, form oil and any other foreign materials.

.2 Extremely smooth surfaces shall be mechanically etched (ie wire brushed) to provide an open pore surface.

.3 Repair concrete as specified in 3.13

.4 Apply approved waterproofing per manufacturer's recommendations for cleaning, pre-moistening, application, and curing.

.5 After the initial set, applications must be kept moist for a minimum of two days. All other curing instructions shall be in accordance with the manufacturer's recommendations.

.2 Under no circumstances shall curing compound be applied to surfaces that will be waterproofed.

.8 Broom Finish

.1 Initiate broom finish following screening and floating of surface.

.2 Brush finish shall be applied with a nylon bristle brush approved by the Contract Administrator. Brushing shall be carried out in such a manner and at such a time as to minimize the depth and quantity of brush marks.

.3 All surplus water must be removed from the bristles before brushing commences.

.4 No mortar coat or water wash shall be used.

END OF SECTION

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PART 1 GENERAL

1.1 Work Included

.1 Refer to Section 01110.

.2 This Section includes all labour, equipment, materials and incidentals for complete and operable heat exchangers as shown on the drawings and specified herein.

.3 Vendor shall fabricate / manufacture / supply all products / equipment.

.4 All equipment shall be factory assembled, cleaned, inspected, successfully tested and shipped as one unit.

.5 All equipment nozzles shall be sealed at the factory with rigid reinforced covers before shipping.

.6 Vendor shall deliver all materials to place of work including shipping, handling and insurance.

1.2 Related Work

.1 Division 01

.2 Section 15098 Piping - Primary Hot Water Side

.3 Section 15099 Piping Specification Sheets

.4 Section 15280 Field insulation

1.3 Quality Assurance and Reference Standards

.1 Work shall be carried out only by qualified tradesmen licensed to practise in the jurisdiction of the Work.

.2 Conform to all applicable standard specifications including but not limited to those referenced herein.

1.4 Local Authority and Jurisdiction

The following bodies have jurisdiction over this project.

.1 Refer to Section 01110.

1.5 Warranty and Compliance

.1 All products / materials included in this scope shall include a one (1) year warranty from the date that the certificate of substantial completion to the installing contractor is signed or as indicated in Section 01110.

.2 It is the responsibility of the supplier to immediately replace any material found non-compliant to the project specifications after delivery to site.

.3 It is the responsibility of the supplier to repair / correct any failure within the warranty period due to factory / manufacturing defects. Provisions shall be employed to avoid normal operation of the system.

1.6 Vendor Submittals

.1 Submit Compliance Statement.

.2 Submit manufacturer's literature and catalogue information:

.3 Submit shop drawings including:

.1 Dimensions, shipping and operating weights.

.2 Materials of construction.

.3 Performance Data (for max and min flows).

.4 Design ratings.

.5 After Delivery, Mill Inspection and Test Plans.

.4 pH / water quality requirements

.5 List of recommended spare parts.

.6 After award and a minimum of 2 weeks before delivery, Vendor to submit a list of all shipped equipment and any loose materials along the shipment.

.7 After award, submit 2 hard copies and 1 soft copy of the Operation and maintenance manuals.

1.7 Units

.1 All suppliers and contractors shall follow the SI metric system for all submissions and correspondence.

1.8 Schedule

.1 All products/materials included in this scope shall be delivered as per the "Work Schedule" as stated in the front-end.

1.9 Discrepancies and Omissions

.1 If a bidder is in doubt as to the meaning of the specifications or bid documents, or finds omissions or discrepancies therein, they shall submit a request for interpretation or correction thereof to the Owner.

1.10 Addenda

.1 Addenda or corrections issued during the bid period shall become part of the Bid Documents.

1.11 Variations

.1 Subject to the requirements given herein, the bidder may submit for consideration, alternative specifications for the Work. These shall be listed accordingly in the Bid

Form. The acceptability of proposed variations/exceptions will be in the sole judgement of the Owner.

PART 2 PRODUCTS

2.1 General

.1 All Equipment shall be CSA B51 and ASME rated (ASME Pressure Vessel Code, Section VIII, Division 1) and have a Canada Registration Number (CRN).

.2 All products shall be new, undamaged, and free from rust and defects.

.3 All products of a similar nature shall be the product of a single manufacturer.

.4 Provide a metallic name plate to be installed / riveted on top of the insulation and include the following for both sides:

.1 Design Flow.

.2 Design Temperatures.

.3 Pressure drop for the design flow.

.5 Provide metal tags above the nozzles to cross reference with technical data sheets.

.6 Design Requirements:

.1 Design Pressure: as per section 01110.

.2 Test Pressure 1.25 times the design pressure.

.3 Design Temperature: as per section 01110.

.4 Maximum pressure drop: as per section 01110.

.7 Standard of Acceptance:

.1 AIC.

.2 Alfa Laval.

.3 Tranter.

.4 SWEP.

.5 Bell & Gossett.

.6 Muller

2.2 Type HX01 - Single Wall Brazed Heat Exchangers

.1 The single wall plate pack shall consist of stainless steel 316 plates with special embossed corrugation patterns and a minimum thickness of 0.35 mm.

.2 Plates shall be turned 180° to each other to create a tight matrix of intersecting flow channels to maximize performance.

.3 Brazing material shall be copper.

.4 Plate patterns shall be designed for counter flow.

.5 Plate pack shall be covered by stainless steel 316 cover plates.

.6 Nozzle connections shall be flanged or stud ANSI class 150 or 300 (Refer to Section 01110 for pressure rating).

.7 Heat exchangers shall be factory insulated. (contractor to submit an alternate price for field insulation if not feasible).

2.3 Type HX02 - Plate and Frame Heat Exchangers

.1 The plates shall consist of stainless steel 316 plates with special embossed corrugation patterns and a minimum thickness of 0.35 mm (per plate).

.2 The plates shall be fully supported in a frame to avoid misalignment in the vertical and horizontal directions.

.3 Plate design shall be self-aligning to locate the plates in the frame and prevent lateral movement and maintain maximum gasket contact under pressure.

.4 Plates shall be reinforced at the mounting slots to prevent bending or twisting.

.5 Plates shall be turned 180° to each other to create a tight matrix of intersecting flow channels to maximize performance.

.6 Plate patterns shall be designed for counter flow.

.7 Plate removal shall be possible for any plate in the pack without the need to remove other plates.

.8 Gasket groove shall allow for gasket expansion.

.9 Gaskets shall be an EPDM one piece clip-on construction (Glue is prohibited).

.10 Nozzle connections shall be flanged or stud ANSI class 150 or 300 (Refer to Section 01110 for pressure rating).

.1 Nozzles shall be at the front cover only.

.2 Front plate shall be the fixed plate.

.3 Rear plate shall be movable with a roller bearing to allow for removal of Stainless Steel Plates.

.11 Frame shall be factory baked epoxy enamel carbon steel in a bolted construction (welding is prohibited).

.12 The carrying/guide bar shall be stainless steel bolted to the frame (welding is prohibited).

.13 All bolts, nuts and washers shall be stainless steel.

.14 Lifting lugs shall be provided to allow lifting of the entire unit.

2.4 Type HX03 - Double Wall Plate and Frame Heat Exchangers

.1 Double wall construction shall be double wall design, consisting of two stainless steel plates separated by thin air gap to enable external visual leak detection.

.2 Double wall design shall prevent cross contamination of fluid streams. Units shall have individual channel leak detectors to allow for leak detection and verification of each individual flow channel.

.3 The double wall plate pack shall consist of stainless steel 316 plates with special embossed corrugation patterns and a minimum thickness of 0.35 mm (per plate).

.4 The plates shall be fully supported in a frame to avoid misalignment in the vertical and horizontal directions.

.5 Plate design shall be self-aligning to locate the plates in the frame and prevent lateral movement and maintain maximum gasket contact under pressure.

.6 Plates shall be reinforced at the mounting slots to prevent bending or twisting.

.7 Plates shall be turned 180° to each other to create a tight matrix of intersecting flow channels to maximize performance.

.8 Plate patterns shall be designed for counter flow.

.9 Plate removal shall be possible for any plate in the pack without the need to remove other plates.

.10 Gasket groove shall allow for gasket expansion.

.11 Gaskets shall be an EPDM one piece clip-on construction (Glue is prohibited.).

.12 Nozzle connections shall be flanged or stud ANSI class 150 or 300.

.1 Front plate shall be the fixed plate.

.2 Rear plate shall be movable with a roller bearing to allow for removal of Stainless Steel Plates.

.13 Frame shall be factory baked epoxy enamel carbon steel in a bolted construction (welding is prohibited).

.14 The carrying / guide bar shall be stainless steel bolted to the frame (welding is prohibited).

.15 All bolts, nuts and washers shall be stainless steel.

.16 Lifting lugs shall be provided to allow lifting of the entire unit.

2.5 Type HX04 - Double Wall Brazed Heat Exchangers

.1 The plates pack shall be double wall design, consisting of two stainless steel plates separated by thin air gap to enable external visual leak detection.

.2 Double wall design shall prevent cross contamination of fluid streams. Units shall have individual channel leak detectors to allow for leak detection and verification of each individual flow channel.

.3 The double wall plate pack shall consist of stainless steel 316 plates with special embossed corrugation patterns and a minimum thickness of 0.35 mm (per plate).

.4 Plates shall be turned 180° to each other to create a tight matrix of intersecting flow channels to maximize performance.

.5 Brazing material shall be copper.

.6 Plate patterns shall be designed for counter flow.

.7 Plate pack shall be covered by stainless steel 316 cover plates.

.8 Nozzle connections shall be flanged ANSI class 150 or 300 (Refer to Section 01110 for pressure rating).

.9 Heat exchangers shall be factory insulated. (contractor to submit an alternate price for field insulation if not feasible).

PART 3 EXECUTION

3.1 Installation Requirements

.1 All heat exchangers shall be installed by the Contractor.

.2 Contractor shall receive, inspect, handle and store all equipment supplied by the Vendor.

.3 All heat exchangers shall be anchored to a housekeeping pad supplied to meet local seismic code.

.4 Where factory insulation is not provided, all heat exchangers shall be field insulated as per Section 15280.

.5 Contractor shall provide provisions for by-passing the heat exchangers during flushing and hydrostatic testing procedures.

END OF SECTION

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PART 1 GENERAL

1.1 General Requirements

.1 All work shall be performed by qualified tradesmen working for a reputable Contracting company experienced in this type of work and shall be strictly in accordance with the best commercial practice.

.2 Coordinate work with the Owner (and other Contractors where applicable) working schedule and cooperate to achieve the earliest possible completion of the work.

.3 Supply all relevant materials, tools and labour to complete all work outlined below.

.4 Refer to Section 15070 for seismic requirements.

.5 Refer to Section 01110 for design temperatures and pressures.

.6 In case of a discrepancy the following order shall be followed:

.1 Piping & Instrumentation Diagrams (P&IDs).

.2 Mechanical Drawings.

.3 Specifications.

1.2 Codes and Permits

.1 The following bodies have jurisdiction over this project.

.1 Refer to Section 01110.

.2 All piping installation on the primary side shall be in accordance to ASME B31.1 and CSA 51.

.3 All piping installation on the secondary side shall be in accordance to ASME B31.9.

1.3 Work Included

.1 Refer to Section 01110 for Summary of Work.

.2 Installation of all Owner supplied material/equipment as per manufacturer recommendations. That includes but is not limited to:

.1 All mechanical works shall be in accordance with Division 15 and all electrical work in accordance with Division 16.

.2 All civil works shall be in accordance to Division 02 and 03.

.3 Installation shall be as per manufacturer recommendations.

.4 Contractor to supply and install flanges to match material / equipment.

1.4 Drawings and Specifications

.1 Contract drawings for mechanical work are in part diagrammatic. They convey the scope of work and indicate the general arrangement of equipment, piping and ductwork. Care shall be taken to ensure that the installation is in accordance with

detailed drawings, wherever applicable, and that the installation meets architectural requirements.

.2 It is intended that these specifications and drawings shall cover the complete mechanical installation ready for uninterrupted operation. Consequently, minor details not necessarily shown or specified but necessary for the proper functioning of the installation, including equipment serviceability, shall be included in the Contractor's estimate.

.3 Any deviation from the mechanical drawings shall be coordinated in writing with the Engineer.

1.5 Shop Drawings

.1 Submit shop drawings in accordance with section 01330 for approval for all fabricated steel piping, gauges, valves, pipe accessories and equipment to be provided under this contract. Also provide shop drawings for tie-in to existing installations.

1.6 Related Work

.1	Section Divisions 00 & 01	General Requirements
.2	Division 15	All Mechanical Sections
.3	Division 16	Electrical

PART 2 PRODUCTS

Refer to section 01220 for quantity take-offs for materials, components and accessories.

2.1 Protection of Materials and Equipment

.1 In addition to the responsibilities outlined in the General Conditions, for care of property and materials, the Contractor shall ensure that the mechanical components shall be given the following attention:

.1 After delivery, before and after installation, protect equipment and materials against theft, injury or damage from all causes.

.2 All materials and equipment stored on site shall be stored as per manufacturer recommendations.

.3 Protect equipment outlets, pipe and duct openings with temporary plugs, caps and canvas.

.4 All motors and/or motor operated equipment and other delicate equipment such as gauges and control panels, etc., shall be stored indoors in a heated space and completely covered with dustproof-sheets until such time as these items are put into operation or tested.

2.2 Quality of Workmanship and Materials

.1 All materials contemplated by these specifications and the plans accompanying them, unless otherwise stated, must be new and at all times open to the inspection, acceptance or rejection of the Owner, but any omission or failure on the part of the Owner to disapprove or reject any work or material shall not be construed to be an acceptance of any defective work or material.

.2 All equipment shall be installed in accordance with Manufacturer's printed installation directions. Erect equipment in neat and workmanlike manner, align, level and adjust for satisfactory operation. Install so that connecting of piping and accessories can be made readily so that all parts are easily accessible for inspection, maintenance and repair.

2.3 Co-operation with Other Trades

.1 Care shall be taken in laying out the mechanical work to accommodate the space requirements for other installations. Particular attention must be given to length of hangers and locations of piping in order to ensure that these components fit into the space allotted, and also to ensure that required head room is provided below piping.

2.4 Screws, Bolts, Fasteners

.1 Screws, bolts and nuts shall be uniform in size, head pattern, material and finish for similar service, and shall be of a type best suited to that service.

2.5 Cleaning and Touch Up Painting

.1 Thoroughly clean all fixtures and equipment of grease, dirt, or other foreign material at the completion of the project.

.2 Chrome-plated and stainless steel fittings, gauge glasses and indicator light lenses shall be polished upon completion of the work.

.3 Any finished surfaces which have become scratched, marred or damaged in any way shall be repaired and refinished or replaced by the Contractor, at the discretion of the Owner’s Representative.

.4 All dirt or rubbish on walls, floors, ceilings or fixtures accumulated from the work of the Contractor or hired subcontractors shall be removed promptly from the premises.

.5 Touch up all other painted surfaces which may become damaged in the course of construction.

2.6 Electrical Power Connections and Wiring

.1 All power and control wiring shall be completed by the Contractor as per Section 01110

.2 All starting and disconnect switches will be provided under Division 16, unless stated otherwise in Division 15. Any additional control relays or switches required and their wiring to ensure the operation of the specified systems shall be provided under Division 16.

2.7 Identification

.1 Coordinate colour coding of piping and equipment with Owner's Representative.

.2 Colour code mechanical equipment and piping.

.3 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow colour, with minimum 20 mm (3/4 in) high black lettering equal to Brady System B-500, vinyl cloth labels for non-insulated surfaces; and Brady B 946 for insulated surfaces.

.4 Identify piping with labels, colour bands, and flow arrows. Provide identification at 5 ft. maximum intervals, before and after pipes connect to heat exchanger nozzles, at all sides of tees, and where pipes terminate at the edge of skid.

.5 Apply colour bands at both ends of the label with primary colour bands used to secure both ends of individual labels.

.6 Provide 20 mm (3/4 in). diameter brass, with metal photo black numbers, or white lamacoid with black engraved numbers, secured to valve stem with key chain.

.7 Tag automatic controls, instruments and relays and match/key to control shop drawing identification numbers. Tag all equipment and control panels.

.8 Identify electric starting switches, thermostats controlling motors, remote push button stations, and controls equipment with lamacoid plates having 6 mm (1/4 in) minimum letter size. Identification to state equipment controlled.

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PART 1 GENERAL

1.1 Summary

.1 Section Includes:

.1 Seismic restraint systems for statically supported and vibration isolated equipment and systems.

.2 Related Requirements:

.1 Division 01 General Requirements

.2 Division 02 Civil

.3 Division 15 Mechanical

1.2 References

.1 Canadian Standards Association (CSA International).

.1 CSA G40.20/G40.21-[04], General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

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

.1 Material Safety Data Sheets (MSDS).

.3 National Building Code of Canada (NBC) - [2010].

1.3 Definitions

.1 SRS: acronym for Seismic Restraint System.

1.4 Description

.1 SRS fully integrated into, and compatible with:

.1 Noise and vibration controls specified elsewhere.

.2 Structural, mechanical, electrical design of project.

.3 Local jurisdiction building code.

.2 Systems, equipment not required to be operational during and after seismic event.

.3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

.4 Designed by Professional Engineer specializing in design of SRS and registered in the local province / jurisdiction.

1.5 Action and Informational Submittals

.1 Submittals: in accordance with Section 01330.

.2 Shop drawings: submit drawings stamped and signed by professional engineer registered in BC.

.3 Submit design data including:

.1 Full details of design criteria.

.2 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).

.3 Separate shop drawings for each SRS and devices for each system, equipment.

.4 Identification of location of devices.

.5 Schedules of types of SRS equipment and devices.

.6 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.

.7 Installation procedures and instructions.

1.6 Delivery, Storage, and Handling

.1 Submittals: in accordance with Section 01330.

PART 2 PRODUCTS

2.1 SRS Manufacturer

.1 SRS from one manufacturer regularly engaged in SRS production.

2.2 General

.1 SRS to provide gentle and steady cushioning action and avoid high impact loads.

.2 SRS to restrain seismic forces in every direction.

.3 Fasteners and attachment points to resist same load as seismic restraints.

.4 SRS of Piping systems compatible with:

.1 Expansion, anchoring and guiding requirements.

.2 Equipment vibration isolation and equipment SRS.

.5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.6 Seismic control measures not to interfere with integrity of firestopping.

2.3 SRS for Static Equipment, Systems

.1 Floor-mounted equipment, systems:

.1 Anchor equipment to equipment supports.

.2 Anchor equipment supports to structure.

.3 Use size of bolts scheduled in approved shop drawings.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Install tight to structure.

.2 Cross-brace in every direction.

.3 Brace back to structure.

.4 Slack cable restraint system.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS for Vibration Isolated Equipment

.1 Floor mounted equipment, systems:

.1 Use one or combination of following methods:

.1 Vibration isolators with built-in snubbers.

.2 Vibration isolators and separate snubbers.

.3 Built-up snubber system approved by Owner's Representative, consisting of structural elements and elastomeric layer.

.2 SRS to resist complete isolator unloading.

.3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.

.4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Slack cable restraint system.

.2 Brace back to structure via vibration isolators and snubbers.

2.5 Slack Cable Restraint System (SCS)

.1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

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 Attachment points and fasteners:

.1 To withstand same maximum load that seismic restraint is to resist and in every direction.

.2 Slack Cable Systems (SCS):

.1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.

.2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.

.3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.

.4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.

.5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.

.6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally and allow for thermal expansion and contraction.

.7 Cable not to support weight during normal operation.

.3 Install SRS at least 25 mm from equipment, systems, services. This minimum clearance should be maintained during thermal expansion and contraction.

.4 Provide flexibility in piping joints or sleeves where pipes pass through building seismic or expansion joints.

.5 At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the centre of gravity of the riser.

.6 Vertical tanks:

.1 Anchor through house-keeping pad to structure.

.2 Provide steel bands above centre of gravity.

.7 Horizontal tanks:

.1 Provide at least two straps with anchor bolts fastened to structure.

3.3 Field Quality Control

.1 Inspection and Certification:

.1 SRS: inspected and certified by Seismic Engineer upon completion of installation.

.2 Provide written report to Owner's Representative with certificate of compliance.

.2 Commissioning Documentation:

.1 Upon completion and acceptance of certification, hand over to Owner's Representative complete set of construction documents, revised to show "as-built" conditions.

3.4 Cleaning

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Standard Specification Revision History:

Rev. No.	Date	By	Chk'd	Comment
0	05/05/2016	AKD	AMF	First Issue
1	13/04/2017	AMF		Title Change
2	04/04/2018	AMF		Added Sections 13.3 & 13.4

Table of Contents

PART 1 GENERAL

1.1 Work Included

.1 This Section covers process mechanical piping, fittings, valves, supports and appurtenances, as shown on the drawings and described in the related Sections.

.2 Provide all labour, materials and incidentals required to construct complete and operable mechanical piping systems, regardless of whether such are specifically called for in the Drawings or Specifications.

.3 Read this Section in conjunction with the Drawings and Contract Documents, particularly the piping specifications. Where there is a conflict, the Owner's Representative shall be notified to resolve it. The Owner's Representative has the right to apply the more stringent requirement in such cases.

.4 Design parameters are outlined in Section 01110 Summary of Work.

1.2 Related Work

.1	Summary of Work	Section 01110
.2	Submittals	Section 01330
.3	Basic Mechanical Methods	Section 15009
.4	Piping Specification Sheets	Section 15099
.5	Valves	Section 15108
.6	Hangers and Supports	Section 15260
.7	Insulation for Piping	Section 15280
.8	Pipe Conditioning	Section 15736

1.3 Quality Assurance

.1 Work shall be carried out only by qualified tradesmen.

.2 Submit qualifications.

.3 Welders shall meet British Columbia Safety Authority (BCSA) requirements.

.4 Conform to all standard specifications referenced herein.

1.4 Reference Standards

.1 ANSI/ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

.2 ANSI/ASME B31.1 Power Piping.

.3 ANSI/ASME B31.9 Building Services Piping.

.4 ANSI B32.1 Metal Products.

.5 CSA CAN3-S16.1-M Steel Structures for Buildings (Limit State Design).

.6 CSA W59-M Welded Steel Construction (Metal Arc Welding).

.7 CSA W47.1 Certification of Companies for Fusion Welding of Steel Structures.

1.5 Submittals

.1 Provide shop drawings for all fabricated steel and stainless steel piping, supports and appurtenances, in accordance with Section 01330.

.2 Submit welder qualifications (WPQ) and welding procedures (WPS) as specified by ASME B31.1 Section 127.5.

.3 Isometrics:

.1 Provide detailed isometric schematics of the piping system:
- i. Provide one isometric schematic for each line.
- ii. Provide Weld Maps for all welds.

.2 The isometric schematic shall contain the following data as a minimum:
- i. All shop weld joints and field weld joints.
- ii. Online valves type and location.
- iii. Pipe supports type and location.
- iv. Pipe anchor points location.
- v. Straight piping sections length and elevation, and branch angles.
- vi. Isometric spool numbering.

.3 The Weld Maps shall contain the following data as a minimum:
- i. Welder ID no. for shop-welded joints.
- ii. Weld number.
- iii. Weld joints subjected to non-destructive test (NDT).
- iv. Welding procedure specification number.

1.6 Delivery, Storage and Handling

.1 Protect all piping, valves and other components from weather and from all damage.

.2 Pre-insulated piping should be stored such that insulated ends are protected from water ingress.

1.7 Piping Specification Sheets

.1 The Piping Specification Sheets (Section 15099) detail the technical requirements for each type of piping system, commodity, and service.

.2 The Piping Specification Sheets do not include requirements such as piping supports and other items required.

PART 2 PRODUCTS

2.1 General

.1 All products shall conform to the Piping Specification Sheets.

.2 All products shall be new, undamaged, and free from rust and defects.

.3 All products of a similar nature shall be the product of a single manufacturer.

.4 Any wetted brass components is prohibited for the main process flow on the primary side without prior approval from the engineer.

2.2 Flanges

.1 Material:

.1 Forged steel to ASTM A105 and ASTM A181.

.2 Stainless steel to ASTM A182

.3 Provide raised-face flange, except when matching an equipment or instrument connection.

.2 Dimensions:

.1 NPS 24 and less: To ASME B16.5.

.2 NPS 30 and above: To ASME B16.47, series A.

.3 Other dimension and/or drilling pattern standard may be required to mate equipment flanges.

.4 Contractor shall verify with manufacturer's data the flange type and size of all free-issued items (equipment, valve, instrument, etc.) provided by the owner.

.3 Bolts and Nuts.

.1 Stainless steel to ASTM A193-B8 Class 2 and A194-8.

.4 Gaskets (Hot Water) / Potable Water.

.1 Material: Non-asbestos synthetic, or Aramid fibers bonded with nitrile (NBR) rubber.

.2 Thickness: 1.6 mm (1/16").

.3 Rating: Refer to Section 01110.

.4 Conforms to ASME B16.21.

.5 Gaskets to be one piece full diameter flange with precision located holes to match the flange bolt pattern.

.6 Install to supplier recommendations.

.7 Gaskets used for potable water service shall be NSF/ANSI 61 certified (Secondary side of domestic hot water (HX-201)).

.5 Gaskets (steam / hot water outside mechanical room).

.1 Type: Spiral wound.

.2 Material: Stainless steel.

.3 Rating: Refer to Section 01110.

.4 Conforms to ASME B16.20

.5 Install to supplier recommendations.

.6 Gaskets (chilled / ambient water).
   i. Material: STYRENE BUTADIENE RUBBER (SBR).
   ii. Conforms to ASME B16.21.
   iii. Thickness: 3 mm (1/8 inch).
   iv. Raised face flange: Flat ring type.
   v. Flat face flange: Full face type.

2.3 Flange Isolation Gaskets

.1 Where indicated on the drawings and at carbon steel to stainless steel connections, install in the place of rubber flange gaskets isolation gaskets to the following requirements:

.1 Gaskets to be full diameter flange insulating gaskets with precision located holes to match the flange bolt pattern, G-10 with EPDM seal elements.

.2 Insulating full-length sleeves to be 0.79 mm thick wall, mylar.

.3 Insulating bolt washers to be 3.97 mm thick, G-10.

.2 Provide Type “E” c/w sleeves and double washer sets to the above requirements.

.3 Standard of acceptance:

.1 PSI Linebacker gaskets (Bedford Pipe & Engineered Products Ltd.).

.2 3-Flow Pointguard gaskets (Martech).

.4 Install to manufacturer’s recommendations, including bolt tightening sequence.

2.4 Strainers

.1 “Y” Type.

.2 Rating: Refer to Section 01110.

.3 Material:

.1 General Service: Carbon steel body with ANSI class flanged ends or welded.

.2 Potable Water Service: 304 stainless steel body with ANCI class flanged ends.

.3 ANSI class to match pressure rating.

.4 Screen:

.1 304 stainless steel screen shall be 5/32 inch with a 30 mesh liner.

.2 Effective screen area shall be minimum 2.5 times the pipe size.

.5 Standard of Acceptance

.1 Mueller 781.

.2 Approved Equal.

2.5 Pipe Sleeves

.1 All pipes, drains and vents passing through concrete walls shall be cast in place with seepage collars as detailed on the drawings. Where seepage collars are not shown a threaded fitting shall be used as a seepage collar. For existing walls, only coring is permitted.

.2 Where pipes pass through floors sleeves shall be used as specified herein.

2.6 Pressure Gauges

.1 Liquid filled 110 mm dial gauge with black lettering (dual scale kPa and PSI).

.2 Range: 0 kPa to 1.2 times the design pressure, as per Section 01110.

.3 Connection ½" NPT – lower mount stainless steel 304.

.4 Accuracy: 1% of scale.

.5 Stainless steel tube, and case with glass or acrylic window with front calibration.

2.7 Temperature Gauges

.1 125 mm dial gauge with adjustable angle, stainless steel case and glass or acrylic window.

.2 Bimetallic hermetically sealed with stainless steel stem extending to 40-60% of pipe diameter.

.3 ½" NPT thermowell with a 50 mm extension for pipe insulation.

.4 Range: 0°C to design temperature, as per Section 01110.

.5 Accuracy: 1% of scale.

2.8 Stainless Steel Piping

.1 Flanges shall be true and perpendicular to the axis of the pipe or fitting. Plain ends of pipe or fittings shall be true and perpendicular to the axis, with edges deburred.

.2 Pipe shall be free from rust, dents and unsightly defects.

.3 Welding in fabricator's shop and in the field shall be performed by qualified welders using approved procedures.

.4 Particular care shall be exercised during fabrication and installation to avoid contact of stainless steel pipe with structural steel, chain, wire-ropes, steel tools, etc., as the contamination of stainless steel by steel may lead to marks due to rusting of imbedded steel.

.5 Pipe Welding

.1 Standards - General

i. ANSI/ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
ii. ANSI/ASME B31.1 Power Piping.
iii. ANSI/ASME B31.9 Building Services Piping.
iv. ANSI B32.1 Metal Products.

v. CSA CAN3-S16.1-M Steel Structures for Buildings (Limit State Design).
vi. CSA W59-M Welded Steel Construction (Metal Arc Welding).
vii. CSA W47.1 Certification of Companies for Fusion Welding of Steel Structures.
viii. ASTM A380-06 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.

.2 Stainless Steel

i. Certify that companies which will be welding stainless steel are CSA-approved.
ii. Weld using ASME qualified welders.
iii. Conform to CSA W47.1, ANSI B31.1 and Section VIII, Division 1 of ASME Boiler and Pressure Vessel Code.
iv. Submit Welding Procedure Specifications.
v. Include in welding procedures the following:
- materials free of grease, oils and other contaminants prior to welding.
- technique that minimizes heat input to parent metal.
- welds free of grain boundary carbide precipitation.
- stainless steel tools, grinding wheels and brushes.

vi. Following removal of weld spatter and slag, finish grind stainless steel surfaces and passivate in accordance with ASTM A380.
vii. Repair welds which do not meet the following acceptance criteria:
- cracks - not permitted.
- incomplete penetration and lack of fusion: Depth - not greater than 0.8 mm length - not more than 38 mm in 150 mm of weld length.
- reinforcement - maximum 3.2 mm.
- undercut - maximum 0.8 mm deep.

.3 Procedures

i. Complete welding in accordance with Part 3.

PART 3 EXECUTION

3.1 General Piping System Installation Requirements

.1 Carefully place and support all pipe at proper lines and grades; where possible slope to permit complete drainage.

.2 Blow or flush all piping clean after assembly and before connecting to equipment.

.3 Handle pipes with care at all times and use equipment designed for the purpose. Replace any pipe damaged in handling or installing.

.4 Install and join pipe in accordance with manufacturer's written instructions and good practice.

.5 Repair factory coatings at field cuts or where otherwise damaged.

.6 All support members shall be hot dip galvanized or coated as per Section 09920.

3.2 Installation

.1 General

.1 Installation shall conform to the provisions of latest release of ASME B31.1 and CSA B51.

.2 Refer to Section 01110 for local jurisdiction.

.3 Follow supplier installation recommendations.

.4 Provide standard weight iron pipe size brass nipples and adapters where copper lines connect to fixtures.

.5 Pipe to pipe branch connections shall not be used.

.6 Ream all cut tube and pipe ends to the full inside diameter at the tube or pipe to remove burrs.

.7 Remove any burrs on the outside of cut tube and pipe ends.

.8 Provide air vents and drains on pipelines wherever indicated on drawings AND manual vent at any local high point, even if air vent is not shown on drawings. All air vents higher than 2.2 m above floor level shall be piped to 1.5 m above floor level

.9 Spring supports shall be locked during testing. Follow supplier recommendations for locking methods.

.2 Permissible Threaded Pipe and Bolt Assemblies

.1 All threaded pipe shall be free of metal shavings. Excess cutting oil shall be removed from pipe.

.2 Only use a Teflon paste type pipe lubricant for threaded assembly. Teflon tape is prohibited.

.3 Teflon tape and alternate paste or liquid lubricants are unacceptable.

.4 When utilizing machine-threaded assemblies for piping connection (i.e. flanges), an anti-seize lubricant shall be applied to machine threads.

.5 All machine-threaded assemblies shall be a minimum of Grade 5 material domestic manufacture.

.3 Permissible Welded Assemblies

.1 Weld rings:

i. Prepare pipe as recommended by manufacturer.

.2 Butt welds:

i. Prepare pipe ends in accordance with ASME B31.1.

.3 Weldolets:

i. Required at branch connections where the branch diameter is smaller than the header diameter.

ii. Reducing tee may be provided, subject to the Owner's Representative acceptance.
iii. Remove slag from inside pipe following installation on 6 inch and larger shop fabrications.

.4 Sockets:
i. Small diameter sockets for instruments, vent, drain, etc. to be rated for 3,000 PSI.

.5 Caps:
i. Use butt-welded caps installed in accordance with ASME B31.1.

.6 Elbows:
i. Use butt-welded fittings.
ii. Elbows to be long radius only, except where indicated on drawings or as stated in Section 15099.

.7 Reducers:
i. Concentric transitions shall be used on vertical piping system, unless otherwise indicated on drawings.
ii. Eccentric transitions shall be used on horizontal piping systems, unless otherwise indicated on drawings.
- Install flat-on-top on all water applications unless otherwise indicated on drawings.
- Install Flat bottom on all steam applications unless otherwise indicated on drawings.

.8 Tees: required at branch connections where a standard reducing tee fitting is available. Weldolets permissible.

.9 Branches: direct unenforced welded branches prohibited. Tees and weldolets permissible.

.4 Pipe Welding

.1 All welding of piping shall be performed in accordance with the latest edition of the Code for Pressure Piping ASME B31.1 and CSA B51.

.2 Each welder's certificate of qualification shall be supplied to the Owner's Representative before any welding is performed.

.3 Provide welding procedure specification and procedure qualification record for each type of weld joint to be used.

.5 Process Piping

.1 Install systems in accordance with ASME B31.1 and CSA B51.

.2 Pitch at 1 mm/m for drainage and air elimination.

3.3 Quality Control

.1 Delivery of all piping and fittings:

.1 Prior to delivery, the Mill Test Report (MTR) shall be submitted to the Owner's Representative for review and acceptance of material.

.2 Upon delivery to the site of all pipes, the Contractor shall verify that the materials received match the MTR submitted by the Contractor's supplier and that it complies with the specifications.

.3 If there is a discrepancy between the documentation and the identification markings on the material or the materials specified, the delivery shall be rejected without any costs to the Owner.

.4 The Contractor shall protect pipe and fittings from oxidation due to the elements or water.

.2 Pre-fabrication of Piping Spools

.1 The Contractor shall maintain a proper control and traceability documentation to verify compliance with the applicable codes and standards and with the Specifications.

.2 The Owner's Representative shall be provided free access to the Contractor's fabrication shop at any time during the fabrication of the piping spools.

.3 The Owner's Representative will review the produced piping spools and control the documents at the Contractor's Workshop prior to delivery.

.4 When the piping spools are fabricated on site instead of at the Contractor's shop, the same requirements apply.

.3 Welder Qualifications

.1 Welder certificates shall be signed by the Contractor and a third party Inspector certifying that all welder and operator qualifications comply with the latest edition of the Code for Pressure Piping, ANSI/ASME B31.1 and all addenda.

.2 All welders performing under these specifications shall have been fully qualified in accordance with the test requirements of Section IX of the ASME Boiler Code.

.3 On-line welder qualification will be applied by radiographing the first three different production welds of each welder.

.4 The Owner's representative may disqualify any welder based on observed competence and/or ability to complete quality work.

.5 Contractors shall utilize the following ASME forms. All copies shall be submitted to the Owner's Representative for review and final acceptance:

i. Welding Procedures Specification (WPS) - Form QW-482.
ii. Procedure Qualifications Record (PQR) - Form QW-483.
iii. Welding Operator Qualifications (WPQ) - Form QW-484.

.6 Provide welding procedures and welding procedure qualification for each type of weld joint to be used.

.7 Each welder shall identify his/her work by stamping each weld with its identification number, indicating joint number and welder ID number. The contractor's name (in abbreviation form or initial), shall prefix the welder's number, thus identifying the entire work. Each welder shall identify his/her

work by stamping each weld, indicating joint number and welder ID number. Tack welds during fabrication shall be made by certified welders.

.8 Each welder must carry an identification badge on them while working. Badge shall be presented to the Engineer representative on request.

.4 Weld Inspection and Testing

.1 All weld inspection and testing expenses shall be covered by the contractor.

.2 Inspection and testing:

i. All welds shall be inspected 100% by visual examination.
ii. Each weld shall be filed as necessary before inspection.
iii. Clean each weld with a power brush to remove slag, platter, etc.
iv. Provide all material, tools, and labor to execute non-destructive tests (NDT).
v. Contractor shall hire an approved 3rd party for all non-destructive testing in accordance to ASME B31.1. All non-destructive testing shall be included in the Contractor's price.
vi. Visual inspections shall be documented and the reports shall become part of the O&M manuals.
vii. Welds to be coated as per Section 15099 after passing visual inspection. The coating shall be applied within 48 hours of welding.

.3 Weld radiographic examination:

i. 100% of all welded joints for underground piping shall undergo radiographic examination.
ii. 20% of all welded joints for above ground shall undergo radiographic examination. Contractor shall coordinate with the Owner's Representative for all welds to be tested.
iii. Any rejected weld shall be repaired and tested at the Contractor's expense. The Owner's Representative shall select an extra weld for inspection for every rejected weld by the same welder at no extra cost to the Owner.
iv. Excessive rejected welds by the same welder may disqualify a welder from any further work, at the discretion of the Owner's Representative.
v. Where radiographic examination is not possible, ultrasonic examination may be used, with the Owner's Representative's permission.
vi. Radiographic examinations shall be documented and the reports shall become part of the O&M manuals.
vii. Welds to be coated as per Section 15099 after passing inspection. The coating shall be applied within 1 week of welding.

.4 Ultrasonic examination may be used:

i. To verify the minimum pipe thickness after grinding.
ii. For initial testing of automatic welds.
iii. Where radiographic examination does not clearly show compliance of the weld.
iv. Where radiographic examination is prohibited for safety concerns.

.5 Magnetic particle examination may be used:

i. For fillet welds.
ii. Any re-beveling.
iii. On completion of weld repairs.
iv. On removal of arc strikes.

3.4 Pressure Tests

.1 General

.1 The use of additives, liquids, compounds and similar substances in pipe systems to provide a leak free system is prohibited.

.2 Valves shall not be used for dead ending a pressure test pipe section. Blind flanges / end caps can be utilized.

.3 Pressure Test limits and duration shall be as per Section 15099.

.2 Pressure test requirements:

.1 All piping shall be hydro-tested as indicated by the Owner's Representative.

.2 Initial and final pressure tests shall be witnessed by the Owner Representative.

.3 All required equipment shall be provided by the Contractor.

.4 Notify the Owner's Representative one week prior to scheduled test date.

.5 Submit piping pressure test method statement one week prior to proceeding to any pressure test.

.6 Submit test report for all pressure tests.

.7 Refer to Section 01110 for local jurisdiction coordination. It is the responsibility of the Contractor to coordinate with the relevant local body for all relevant tests inspections as required by local code.

.8 Costs for pressure testing shall be borne by the Contractor.

.9 All pressure testing for underground piping shall include a timer chart assembly.

.10 An acceptable pressure test shows no drop in pressure over the duration of the test.

3.5 Piping Through Concrete, Masonry and Walls

.1 Where pipe passes through walls, exercise extreme care to insure that joints are watertight.

.2 Free pipe of all dirt and grease to secure a tight bond with concrete.

.3 Pipe to be grouted with non-shrink grout as per section 03050.

3.6 Fire-stopping Specifications

.1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations. The contractor is required to

coordinate with the architectural drawings to contractual rated wall types and installation details.

.2 Fire-stopping materials to meet ULC CAN 2S115. Acceptable Materials: by "Tremco" or "National Firestopping", “Hilti”, “3-M”.

.1 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per manufacturer’s instructions.

3.7 Tolerances for Pipe Installation

.1 Install piping precisely to the dimensions shown on drawings. Any conflicts should be reported to the Engineer immediately.

.2 Cast sections of major piping into place only after piping has been assembled in place. Spool pieces may be substituted for long delivery items.

3.8 Unions

.1 Unless otherwise specified, provide unions in all piping connections to all items of equipment to permit the removal of each and every device without dismantling the pipe.

3.9 Welding of Stainless Steel Pipe

.1 Submit certificates of welders to Owner’s Representative for review. Also submit sample weld for testing.

.2 Carry out all welding using certified welders employing approved procedures to ASME standards for stainless steel.

.3 Select the appropriate stainless steel electrodes and filler rods from the following table.

Piping	Electrode	Filler Rod
316 to 316SS	A298-E316 -15	316
316L to 316LSS	A298-E316 ELC-15	316L
316L to 304LSS	A298-E308 ELC-15	308L
304 to 304SS	A298-E308 -15	308
304L to 304LSS	A298-E308 ELC-15	308L

.4 For piping or tubing, tape the assembled joint around the exterior to avoid excessive leakage of the shielding or purge gas. Purge the interior of the pipe using Argon or Helium inert gas. Do not use nitrogen. Use of a gas-backing device to reduce purge gas requirement is permitted.

.5 Employ a gas tungsten-arc welding process (TIG) for the root pass of all welds. Use filler rods selected from the table above and argon gas for shielding the torch. All root passes require full uniform penetration without weld shrinkage, porosity or

incomplete penetration to provide uniform reinforcement smoothly blended into the parent metal surfaces.

.6 Use the shielded metal arc process on all successive passes employing electrodes selected from the table above and conforming to ASTM A298 and AWS 5.4.

.7 After each pass, remove all slag and flux from each crater by chipping before proceeding. Thoroughly clean each complete bead or layer by chipping and wire brushing using only stainless steel tools and brushes. Remove all weld splatter from pipe ends and weld surfaces before laying down the next successive bead or layer. Grind away any cracks or blow holes that appear on the surface of any bead of welding before depositing the next successive bead.

.8 Provide finished welds with full penetration, but with no shrinkage or porosity.

.9 Anneal all welds on stainless steel after welding unless a grade of extra low carbon stainless steel is used. Remove annealing scale by tumbling followed by pickling in acidic solutions as recommended by the stainless steel supplier.

.10 Submit welding procedure to the Owner's Representative for approval if the Contractor wishes to deviate from the above procedure.

.11 Clean and passivate all welds in accordance with ASTM A380.

.12 Do no pre-heating under this procedure, except that if material must be welded during freezing temperatures, ensure material is warm and dry before welding is commenced.

.13 Following cleansing of welds wash completed lines with steam or hot water.

3.10 Flushing, Cleaning and Passivation

.1 Supply all temporary equipment and bypasses required for pipe flushing even if not shown on the drawings.

.2 Supply manpower to remove all temporary bypasses after the completion of the flushing and to complete connections to equipment.

.3 Provide all the manpower, tools, chemicals and equipment required for the flushing, cleaning, and passivation as instructed by the Owner's Representative.

.4 Flushing, cleaning, and passivation procedures for all piping networks are summarized in Section 15736.

3.11 Hot Water Pre-stressing (if required)

.1 Contractor to provide pre-stressing procedure to the engineer a minimum of 10 days prior to starting pre-stressing.

.2 Pre-stressing temperature to be determined in consultation with the engineer.

.3 During pre-stressing, pipe must reach pre-determined temperature prior to backfill. Contractor to measure pipe expansion by taking a measurement of pipe length before and after heating to ensure expansion is achieved. If the desired expansion is not achieved, increase the temperature of the pipe in 5 °C increments until the pipe has reached the desired expansion.

.4 The pre-stress temperature must be maintained until a minimum of 600 mm backfill is placed and compacted above the pipes.

.5 Pre-stressing to be completed in one continuous operation, such that all pipes where the expansion will be affected by the pre-stress are pre-stressed at the same time, unless otherwise approved by the engineer.

3.12 E-Compensators (if required)

.1 Adjust e-comp to pre-setting as per design drawings and the manufacturer Handling and Installation Manual.

.2 Fix/tack the e-comp by means of tack welds or fixing bars prior to placement; remove tack welds prior to welding to ensure full compression of the e-comp.

.3 E-comps shall not be exposed to bending strain during handling/welding (i.e. e-comp shall only be welded between straight sections of pipe).

3.13 Leak Detection

.1 This section is related to direct buried pre-insulated piping (Section 15099 Type S03)

.2 The leak detection system shall be installed in accordance to EN 14419

.3 Leak detection shall be installed as per the latest published version of the supplier installation manual

.4 Contractor to keep daily field reports of measurements (continuity ohmic resistance and insulation resistance) for each pipe component after it is added and submit to the engineer on a weekly basis

.5 Contractor to ensure joints are free of moisture before completing the joint insulation

.6 Before tying in to an existing system, Contractor to obtain necessary approval from the operator and ensure the existing system is not producing any faults

.7 Contractor to provide a drawing with the leak detection wire lengths between all junction boxes installed within the scope of work and mark locations that has been looped.

.8 Contractor to return after 4 weeks from commissioning to ensure the leak detection system measurements are within supplier recommended thresholds

3.14 Hydrotest (for Section 15099 Type S03 only)

.1 The following requirements are only applicable for Section 15099: Type S03

.2 This section shall be read in conjunction with Section 3.4 above

.3 All piping sections installed within the scope of work shall be hydrotested

.4 Contractor to coordinate with the applicable local jurisdiction / safety authority

.5 Ensure that all the welds are exposed for the hydrotest or the leak detection system is commissioned prior to the test (approval from the local jurisdiction / safety

authority shall be confirmed by the contractor before covering the welds prior to hydrotest)

.6 Inform the Owner representative 1 week prior to the pressure test and ensure the pressure test is witnessed accordingly (either by the safety authority representative or the Owner representative)

.7 Submit a hydrotest procedure for final review and approval that shall as a minimum:

.1 Include a sketch / marked up drawings that shows the pipe sections boundaries to be tested and the location of the safety barricade signs to be provided

.2 Include pressure and test duration as indicated in Section 15099

.3 Indicate how the pipes will be filled and drained and include any necessary permits required by the applicable local jurisdiction

.4 Include a calibration certificate for the pressure measuring device

.5 The pressure measuring device shall include a time recorder that will show the pressure values through out the full pressure test duration

.6 Indicate a step by step procedure for filling and venting

.8 If the hydrotest pressure value does not hold for the test duration, ensure the pressure is reduced to 15 psi max before making any adjustments / repairs

.9 If the hydrotest holds, complete a visual inspection to ensure there are no leaks. In case the welds were covered (with prior approval) the leak detection system shall be utilized before and after the hydrotest to ensure no leaks.

.10 Contractor to ensure hydrotest QA/QC form is signed by the Owner witness and included along with the recorder chart in the O&M manuals

END OF SECTION

Standard Specification Revision History:

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Type C01	**Copper Piping**
Service	Hard-drawn copper tube for potable water service
Operating Pressure rating	Secondary Domestic Hot Water Piping Design Pressure as per Section 01110
Temperature rating	Secondary Domestic Hot Water Piping Design Temperature as per Section 01110
Test Condition	1.5 times Design Pressure for 120 minutes

Item	Sizes	Specification
Basic Material & Reference Standard	2 inch and less	• Copper piping to ASTM B88
Thickness	2 inch and less	Type L (ASTM B88)
Fittings / Joints	2 inch and less	• Wrought copper to ANSI B16.22 • Long radius Elbows • Brazed connections to ASTM B32. Solder to AWS A5.8, classification BCuP-5 with a minimum melting point of 537 °C

Notes

1. All materials to be compatible with potable water systems and in accordance with local building code

Type H01		**High-Density Polyethylene Piping**
Service		Primary DES Piping (below ground)
Basic Material & Reference Standard		HDPE to AWWA C906, manufactured to ASTM F714 and CGSB-41-GP-25M
Ends		Flanged (Vanstone)
Operating Pressure		Refer to Section 01110
Pressure Rating		Refer to Section 01110
Size Range		200-500 mm
Temperature rating		Refer to Section 01110
Test Condition		1.5 times the design pressure for 120 minutes
Item	**Sizes**	**Specification**
Pipe	250 – 500 mm	DR17, PE 3608
Joints	250– 500 mm	Fusion welded
Fittings	General	Pipe fittings shall be designed in accordance with the requirements of AWWA C906 by the pipe manufacturer for the design working pressure. Fittings shall be molded, thermo-formed from pipe sections, or fabricated by heater fusion. Conform to ASTM D3261. Fabricated fittings shall be fabricated from stock of at least 25% greater thickness than the adjoining straight piping.
Flanges	General	Flanged joints to AWWA C906 flat faced stub end and loose stainless steel backup ring drilled to ANSI B16.5 class 150
Flange Gaskets	General	Black neoprene to ANSI B16.21
Insulation	General	None
Test Procedure	General	As per Section 15098
Quality Control	General	Submit all welding machine reports
Notes		
1. Supply and install copper tracing wires above all buried HDPE piping. 2. Supply and install a warning tape above all buried HDPE piping. 3. All HDPE components shall be protected from direct sun light during storage.		

Type S01		**Carbon Steel Process Piping (Welded)**
Service		Primary Hot Water / steam (above ground)
Operating Pressure Rating		Refer to Section 01110
Temperature Rating		Refer to Section 01110
Test Condition		1.5 times the Design Pressure for 120 minutes
Item	**Sizes**	**Specification**
Basic Material & Reference Standard	2 inch and less	• Plain Ends • ASTM A106, grade A seamless, or • ASTM A53, grade B
	2½ inch to 12 inch	• Beveled ends • ASTM A106, grade A seamless, or • ASTM A53, grade B
	14 inch and above	• Beveled ends • ASTM A106, grade A seamless, or • ASTM A53, grade B, or • API 5L double submerged arc welded
Thickness	2 inch and less	ASME B36.10, schedule 80
	2½ inch to 12 inch	ASME B36.10, schedule 40
	14 inch to 24 inch	ASME B36.10, standard weight (0.375”)
Fittings / Joints	¾ inch and below	Threaded socket fittings, material to ASTM A105 and dimensions to ASME B16.11
	1 inch to 2 inch	Welded socket fittings, material to ASTM A105 and dimensions to ASME B16.11
	Above 2½ inch	Butt-welded, black steel with bevelled ends for welding, to ASME B16.9, same wall thickness as pipe (Elbows shall be long radius)
Welding Outlets	14 inch to 24 inch	Weldolets, sockolets and thredolets to ANSI B16.9, ANSI B16.11 and ANSI B31.1
Insulation	All	As per Section 15280

Notes

1. All welded joints shall be painted with an alkyd primer with a minimum dry film thickness of 2.5 mils suitable for 120°C after visual inspection and within 1 week of welding (See Spec 15098 #3.3.3.8-9).
2. All exposed piping installed in air-conditioned space shall be painted with an alkyd primer with a minimum dry film thickness of 2.5 mils suitable for 120 °C.
3. All exterior piping (e.g. within a manhole) shall be painted with an alkyd primer (minimum dry film thickness of 3 mils) suitable for 120 °C and a compatible epoxy coating (minimum dry film thickness of 3 mils).
4. Flanged joints will be accepted at the discretion of the engineer.

Type S02		**Carbon Steel Process Piping (Grooved)**
Service		Primary ambient / chilled / Secondary (above ground)
Operating Pressure Rating		Refer to Section 01110
Temperature Rating		Refer to Section 01110
Test Condition		1.5 times the Design Pressure for 120 minutes
Item	**Sizes**	**Specification**
Basic Material & Reference Standard	2 inch and less	• Plain Ends (roll grooved or NPT) • ASTM A106, grade A seamless, or • ASTM A53, grade B
	2½ inch to 12 inch	• Plain ends (roll grooved) • ASTM A106, grade A seamless, or • ASTM A53, grade B
	14 inch and above	• Plain ends (roll grooved • ASTM A106, grade A seamless, or • ASTM A53, grade B, or • API 5L double submerged arc welded
Thickness	2 inch and less	ASME B36.10, schedule 80
	2½ inch to 12 inch	ASME B36.10, schedule 40
	14 inch to 24 inch	ASME B36.10, standard weight (0.375”)
Fittings / Joints	0.5 inch to 2 inch	Victaulic Style 07 rigid couplings or approved equal (NPT permissible)
	Above 2½ inch	Victaulic Style 07 rigid couplings or approved equal (Welded permissible as per Type S01)
	14 inch to 24 inch	Victaulic Style 07 rigid couplings or approved equal (Welded permissible as per Type S01)
Insulation	All	As per Section 15280

Notes

1. Refer to Drawings if flexible mechanical joints are required
2. All welded joints shall be painted with an alkyd primer with a minimum dry film thickness of 2.5 mils suitable for 120°C after visual inspection and within 1 week of welding (See Spec 15098 #3.3.3.8-9).
3. All exposed piping installed in air-conditioned space shall be painted with an alkyd primer with a minimum dry film thickness of 2.5 mils suitable for 120 °C.
4. All exterior piping (e.g. within a manhole) shall be painted with an alkyd primer (minimum dry film thickness of 3 mils) suitable for 120 °C and a compatible epoxy coating (minimum dry film thickness of 3 mils).
5. Flanged joints will be accepted at the discretion of the engineer.

Type S03	**Pre-Insulated Carbon Steel Process Piping**
Service	Primary Hot Water (Underground)
Operating Pressure Rating	Refer to Section 01110
Temperature Rating	Refer to Section 01110
Test Condition	1.5 times the Design Pressure for 120 minutes
Standard of Acceptance	Logstor® or approved equal
Standard of Compliance	EN 253 Pre-insulated bonded pipe for hot water district heating EN 448 Pre-insulated fittings EN 488 Pre-insulated valves EN 489 Joint kits EN 14419 Surveillance system (leak detection) EN 13941 Design and installation

Type SS01		**Stainless Steel Process Piping**
General		
Basic Material & Reference Standard		SS to ASTM A778
Ends		Butt Weld
Pressure Rating		Refer to Section 01110
Size Range		50-250 mm
Temperature Rating		Refer to Section 01110
Test Condition		1.5 times the design pressure for 120 minutes
Pickling Procedure		Pickle SS piping as per ASTM A380
Item	**Sizes**	**Specification**
Pipe	2 – 10 inch	Schedule 10S, SS 304 to ASTM A778.
Joints	2 – 10 inch	Full-penetration butt weld
Fittings	General	SS 304 stainless steel to A774, fabricated fittings as shown, except as noted.
Elbows	2- 10 inch	Smooth design, pressed type, welded
Flanges	General	weld-neck or slip-on to ANSI B16.5, raised face, except adjacent to equipment with flat face flanges (ANSI class to meet design pressure rating)
Bolting (flanges and couplings)	General	Stainless steel
Coupling	General	Dresser Style 38 – SS304, restrained as per AWWA M11
Lining (interior)	General	None

Type P01	**Cross-linked Polyethylene Piping**
Service	Primary DES Piping (below ground)
Pressure Rating	Refer to Section 01110
Size Range	50 mm to 160 mm
Temperature Rating	Refer to Section 01110
Test Condition	1.5 times the design pressure for 120 minutes.
Standard of Acceptance	Kelit® or approved equal
Notes	
1. Supply and install copper tracing wires above all buried PEX piping. 2. Supply and install a warning tape above all buried PEX piping. 3. All PEX components shall be protected from direct sun light during storage. 4. PEX shall come with a built-in leak detection system.	

END OF SECTION

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PART 1 GENERAL

1.1 Work Included

.1 This Section includes all labour, materials and incidentals for complete and operable valves, operators and appurtenances as shown on the drawings and specified herein.

.2 Read this Section in conjunction with the Drawings and Contract Documents, particularly the piping specifications. Where there is a conflict, conform to the most stringent requirements.

1.2 Related Work

.1	Piping - Hot Water	Section 15098
.2	Piping Specification Sheets	Section 15099
.3	Valves Specification Sheets	Section 15109

1.3 Quality Assurance and Reference Standards

.1 Work shall be carried out only by qualified tradesmen.

.2 Conform to all standard specifications referenced herein.

1.4 Submittals

.1 Submit manufacturer's literature and catalogue information for all valves and actuators prior to ordering any materials.

.2 Submit list of recommended spare parts with current prices for valves and equipment.

1.5 Delivery, Storage and Handling

.1 Protect all valves from weather, and from all damage.

1.6 Valve Specification Sheets

.1 The Valve Specification Sheets (Section 15109) detail the technical requirements for each type of valve specified, including the valve materials, performance requirements and reference specifications.

.2 The Valve Specification Sheets do not necessarily include requirements such as actuator supports and other items required.

.3 All valves of a particular code shall be from the same manufacturer.

PART 2 PRODUCTS

2.1 General

.1 All products shall conform to the Valve Specification Sheets.

.2 Named Acceptable Products are given in the Valve Specification Sheets to define basic materials and performance criteria required for each valve type.

.3 All products shall be new, undamaged, and free from rust and defects.

.4 All products of a similar nature shall be the product of a single manufacturer.

2.2 Definitions

.1 Abbreviations used in Detailed Valve Specification Sheets:

AV - Angle Valve
BC - Balancing Cock Valve
BD - Butterfly Damper
BF - Butterfly Valve
BV - Ball Valve
CB - Circuit Balancing Valve
CV - Check Valve
DV - Diaphragm Valve
GA - Gauge/Root Valve
GL - Globe Valve
GV - Gate Valve
KV - Knife Gate Valve
MV - Mud Valve
NV - Needle Valve
PD - Pump Discharge (Triple Duty) Valve
PN - Pinch Valve
PR - Pressure Reducing/Relief Valve
PV - Plug Valve
TW - Two Way/Three Way Multiport Valve

PART 3 EXECUTION

3.1 Installation Requirements

.1 All valves shall be installed as per supplier recommendations.

.2 All valves shall be installed in a cracked open position.

3.2 Chain Operators

.1 Provide chain operators for valves located 2,200 mm or higher above finished floor level.

.2 Extend chain to an elevation of 1,500 mm above finished floor level.

3.3 Vents and Drains

.1 All drains shall be furnished with an elbow and a cap with a chain.

.2 All vents shall be furnished with a plug.

.3 Provide drains at all low points, for all strainers and equipment.

.4 Provide vents at all high points. Vents should be piped to within 1.5 m from the ground, as per drawing details. All Vents should be piped such that the outlet points towards the ground.

3.4 Check Valves

.1 One Check valve shall be installed downstream each pump or as stated in the drawings.

.2 Provide a minimum of five (5) diameters of straight length upstream of check valves.

END OF SECTION

Standard Specification Revision History:

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1	22/11/2017	AMF		PR-03 added

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Automatic Air Release Valve	**AR-01**
General	
Description	Lever type air release valve
Basic Material & Reference Standard	Cast iron ASTM A126, Class B
Ends	NPT female connections
Pressure Rating	1,034 kPa (150 psi)
Temperature Rating	Match piping design temperature
Size Range	19 mm (3/4”) inlet, 9 mm (3/8”) outlet
Service	Primary Side Hot Water
Materials	
Body	Cast iron ASTM A126, Class B
Cover	Cast iron ASTM A126, Class B
Float	304 stainless steel
Float Arm	304 stainless steel
Valve Head	EPDM
Coating	Epoxy
Notes	
1. Valve discharge piping shall be routed to floor. Piping size to match valve outlet. 2. All valves shall have a registered CRN number as required by the local safety authority.	
Standard of Acceptance	
Spirax Sarco 13WHS	

Butterfly Valve	**BF-01**
General	
Description	One-piece Body Cast iron butterfly valve
Basic Material & Reference Standard	Cast Iron
Pressure Rating	Min. 1,034 kPa (200 psi) or match piping design pressure (whichever is higher) at the design temperature
Temperature Rating	Match piping design temperature
Size Range	38 to 300 mm (1.5” to 12”)
Service	Space Heating Secondary Side Isolation
Materials	
Body	Lugged or wafer body
Disk	316 stainless steel
Seat	EPDM
Shaft	One-piece shaft
Ends	Lugged or flanged (ANSI class to match pressure rating)
Operator	
Handle	- Provision for padlocking.
Notes	
1. Blowout proof shaft required. 2. All valves shall have a registered CRN number as required by the local safety authority.	
Standard of Acceptance	
DeZurik BOS Butterfly Valve	

Ball Valve	**BV-01**
General	
Description	Ball Valves
Basic Material & Reference Standard	Carbon Steel
Ends	Bevel end (welded) or Flanged ANSI B16.34 (ANSI class rating to meet design pressure requirements)
Pressure Rating	Min. 1,380 kPa (200 psi) or match piping design pressure (whichever is higher)
Temperature Rating	Match piping design temperature
Size Range	50 to 200 mm (2” to 8”)
Service	Primary and Secondary Side Hot Water Isolation
Materials	
Body	Sch. 40 Carbon Steel
Ball	Stainless Steel A351 CF8M (316)
Seats	Teflon (PTFE TFM-1600)
Stem	Stainless Steel A276 Type 316
Operator	
Lever Actuator	• Ductile Iron or Epoxy coated steel construction. • Provision for padlocking.
Notes	
1. All valves shall have a registered CRN number as required by the local safety authority. 2. Blowout-proof stem.	
Standard of Acceptance	
M.A. Stewart F-150-CS-R-SS-N (Class 150) M.A. Stewart F-300-CS-R-SS-N (Class 300) Broen (Ballomax) Armour Valve (Bohmer)	

Ball Valve	**BV-02**
General	
Description	Two-piece steel ball valve
Basic Material & Reference Standard	Carbon steel
Ends	Refer to piping spec section 15099
Pressure Rating	4,136 kPa (600 psi)
Temperature Rating	Match piping design temperature
Size Range	13 – 38 mm (½" to 1½")
Service	Vents and Drains on Primary Side Hot Water and on Space Heating Secondary Side
Materials	
Body	Carbon steel, 2-piece
Ball	316 Stainless steel
Seat	Teflon
Shaft	Stainless steel (note 1)
Operator	
Handle	Epoxy coated steel
Notes	
1. Blowout-proof shaft required. 2. Refer to Sections 15098 and 15099 for applicable ends depending on pipe size 3. All valves shall have a registered CRN number as required by the local safety authority. 4. Non-shock valve.	
Standard of Acceptance	
Apollo Valves Series 72-140	

Ball Valve	**BV-03**
General	
Description	Two-piece stainless steel ball valve
Basic Material & Reference Standard	Stainless Steel A351 CF8M (316)
Ends	Refer to piping spec section 15099
Pressure Rating	2,760 kPa (400 psi)
Temperature Rating	Match piping design temperature
Size Range	5 – 80 mm (1/4” to 3”)
Service	Domestic Hot Water Secondary Side Isolation, Drain, Vent and Gauges; Exterior Piping Bypass
Materials	
Body	Stainless Steel A351 CF8M (316)
Ball	Stainless Steel A351 CF8M (316)
Seat	R-PTFE 15% Glass Filled
Stem	Stainless Steel A276 Type 316
Operator	
Handle	Stainless Steel A276 Type 304
Notes	
1. Blowout-proof shaft required. 2. All valves shall have a registered CRN number as required by the local safety authority.	
Standard of Acceptance	
M.A. Stewart G-2	

Pre-Insulated Welded Ball Valve	**BV-04**
Service	Buried Primary Hot Water
STANDARD OF ACCEPTANCE	
Logstor/Urecon Comp. 4200, 4220, 4240	

Needle Valve	**NV-01**
General	
Description	Needle Valves
Basic Material & Reference Standard	Carbon Steel
Ends	NPT
Pressure Rating	65,000 kPa @ 37 °C
Temperature Rating	Match piping design temperature
Size Range	13 mm (½")
Service	Primary Side Gauges Only; Space Heating Secondary Side Gauges Only
Materials	
Body	Sch. 40 Carbon Steel
Stem	416 Stainless Steel
Packing	Teflon
Note	
1. All valves shall have a registered CRN number as required by the local safety authority.	
Standard of Acceptance	
Kertotest N28	

Needle Valve	**NV-02**
General	
Description	Needle Valves
Basic Material & Reference Standard	Stainless Steel
Ends	NPT
Pressure Rating	65,000 kPa @ 37 °C
Temperature Rating	Match piping design temperature
Size Range	13 mm (½")
Service	Secondary DHW gauges only
Materials	
Body	ASTM A182 Type 316 Stainless Steel
Stem	ASTM A582 Type 303 Stainless Steel
Packing	Teflon
Notes	
1. All valves shall have a registered CRN number as required by the local safety authority.	
Standard of Acceptance	
Kerotest N28	

Pressure Relief Valve	**PR-01**
General	
Description	Direct-operated, spring loaded pressure relief valve
Basic Material & Reference Standard	Bronze B584 Alloy 84400
Ends	19 mm (¾") NPT inlet
Pressure Rating	2,068 kPa (300 psi)
Temperature Rating	Match piping design temperature
Size Range	19 mm (¾")
Service	Primary Side Hot Water; Space Heating Secondary Side; Domestic Hot Water Secondary Side
Setting	Refer to Section 01110 Part 6 and P&IDs
Materials	
Body	Bronze
Disc/Retainer	Stainless Steel
Seat/Seal	Buna-N
Notes	
1. All valves shall have a registered CRN number as required by the local safety authority.	
Standard of Acceptance	
Kunkle Model 918	

Pressure Relief Valve	**PR-02**
General	
Description	Direct-operated, spring loaded pressure relief valve
Basic Material & Reference Standard	304/316 Stainless Steel
Ends	19 mm (¾") NPT inlet
Pressure Rating	3,447 kPa (500 psi)
Temperature Rating	Match piping design temperature
Size Range	19 mm (¾")
Service	Secondary Domestic Hot Water – Potable Water
Setting	Refer to Section 01110 Part 6 and P&IDs
Materials	
Body	Stainless Steel
Disc/Retainer	Stainless Steel
Seat/Seal	Buna-N
Notes	
1. Alternatively, provide bronze body pressure relief valve to the above requirements that is NSF/ANSI 61 certified for potable water service. 2. All valves shall have a registered CRN number as required by the local safety authority.	
Standard of Acceptance	
Kunkle model 917	

Pressure Relief Valve	**PR-03**
General	
Description	Direct-operated, spring loaded temperature pressure relief valve
Ends	19 mm (¾") NPT inlet
Pressure Rating	Refer to P&IDs
Temperature Rating	Match piping design temperature
Size Range	19 mm (¾")
Service	Domestic Hot Water Secondary Side
Setting	Refer to P&IDs
Materials	
Body	Bronze
Disc/Retainer	Stainless Steel
Notes	
1. Valve shall be rated for potable water applications 2. All valves shall have a registered CRN number as required by the local safety authority.	
Standard of Acceptance	
Watts Series 40XL	This model series is not acceptable for pressure set points higher than 150 psi.

END OF SECTION

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PART 1 GENERAL

1.1 Section Includes

.1 Hangers and supports for mechanical piping.

1.2 Related Sections

.1	Piping Hot Water	Section 15098
.2	Piping Specification Sheets	Section 15099

1.3 References

.1 American Society of Mechanical Consultants (ASME):

.1 B31.1 - Power Piping (SI Edition).

.2 B31.9 - Building Services Piping.

.2 ASTM International (ASTM):

.1 A36 - Standard Specification for Carbon Structural Steel.

.3 Manufacturers Standardization Society of The Valve and Fittings Industry (MSS) Standard Practices:

.1 SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 SP-69 Pipe Hangers and Supports - Selection and Application.

.3 SP-77 Guidelines for Pipe Support Contractual Relationships.

.4 SP-89 Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 SP-90 Guidelines on Terminology for Pipe Hangers and Supports.

.6 SP-127 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application.

1.4 Submittals

.1 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Load capacity and sizing schedules specific to Project.

.3 Installation methods.

.2 Certifications:

.1 Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements. Certificates shall be furnished only as required by specific codes, upon request.

.3 Shop Drawings:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

Closeout Submittals:

.4 Warranty: Warranty documents.

.5 Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

1.5 Quality Assurance

.1 Manufacturer Qualifications:

.1 Manufacturing facilities shall be registered to ISO 9001.2000 and assessed to ISO 9000.2000 standard. A copy of the current certificate shall be available upon request.

.2 Installer Qualifications:

.1 Utilize an installer experienced in performing work of this section who is experienced in installation of work similar to that required for this project and per the minimum requirements of MSS SP-89.

.3 Conduct pre-installation meeting to verify project requirements, coordinate with other trades, and establish condition and completeness of substrate. Review manufacturer's installation instructions and manufacturer's warranty requirements.

1.6 Delivery, Storage, and Handling

.1 Store products in manufacturer’s unopened packaging until ready for installation.

.2 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 Project Conditions

.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 Warranty

.1 Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights, Owner may have under Contract Documents.

PART 2 PRODUCTS

2.1 General

.1 All pipe hangers shall be in accordance to MSS-SP 58, ASME B31.1 and CSA B51.

2.2 Manufacturers

.1 Standard of Acceptance: Anvil Intl., Inc. Adjustable Clevis for insulated lines, Fig. 300.

.2 Substitutions: Permitted, subject to Consultant approval.

2.3 Manufactured Units - Application Requirements

.1 Fabricate hangers, supports and sway braces to comply with building codes.

.1 Fabricated supported to be sealed by a professional engineer certified in the local jurisdiction

.2 Do not use installed hangers for rigging or erection purposes.

.3 Application Requirements: Use components for intended service conditions only. Comply with service requirements below unless noted otherwise on drawings and schedules.

.1 Steel hangers in contact with dissimilar metal shall be isolated to avoid dielectric effect.

.2 Exterior utility and mechanical yard areas in conditions where corrosion is likely shall use piping that is hot dip galvanized.

.3 Interior piping to be black iron.

.4 Hydronics and plumbing piping hangers shall be manufactured from carbon steel, cast malleable iron or cast iron.

.5 STEAM piping hangers shall be manufactured from Chrome Molybdenum steel.

.6 Submerged piping hangers shall be manufactured from 316 stainless steel.

PART 3 EXECUTION

3.1 Contractor General Requirements

.1 Incorporate in construction pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Comply with maximum load ratings with consideration for allowable stresses prescribed by ASME B31.1 or MSS SP-58.

.3 Provide supports, guides and anchors that do not transmit unacceptable heat and vibration to building structure.

.4 The selection of pipe hangers and supports shall be based upon the overall design concept of the piping systems and any special requirements, which may be called for in the specifications. The support systems shall provide for, and control, the free or intended movement of the piping including its movement in relation to that of connected equipment.

.5 Provide for vertical adjustments after installation of supported material and during commissioning, where feasible, to ensure pipe is at design elevation and slope.

.6 Contractor shall appoint a registered Professional Engineer certified in the local jurisdiction to review the seismic loading of all support systems as shown on the contractor's shop drawings and provide stamped approval indicating the proposed support systems meet the requirements of all applicable codes. Any additional restraints shall be approved by the Engineer.

.7 The Contractor shall provide all pipe hangers, supports, guides, anchors, brackets and related appurtenances required for the installation of the piping and equipment, regardless of whether these are shown on the drawings.

.8 Pipe shall not be hung from or supported by other pipe.

.9 Perforated band, iron wire, or chain hangers will not be approved.

.10 All pipe hangers shall be oversized to be installed over the insulation where a vapor barrier need to be maintained. Contractor to utilize inserts / saddles accordingly.

3.2 Selection of Hangers and Supports for Pipe Movement

.1 Select hangers and supports to perform under all conditions of operation, allowing free expansion and contraction, and to prevent excessive stresses being introduced into piping system and connected equipment. Anchors shall be provided wherever necessary to protect equipment and control direction of pipe movement. Pipe guides shall be provided at each side of each expansion joint.

.2 Angularity of rod hanger resulting from horizontal movement of the piping system from cold to hot positions shall not to exceed 4 degrees from vertical.

.3 Where horizontal pipe movement is greater than 1/2 inch (12.7 mm), offset pipe hanger and support so that rod hanger is vertical in hot position.

.4 Where significant vertical movement of the pipe occurs at the hanger location, a resilient support must be used. Selection of resilient supports shall be based on permissible load variation and effects on adjacent equipment. Support selection for typical load variations are shown in Table 2 of MSS-SP-69. Load and movement calculations shall be made for the proper selection of spring hangers. Vertical movement and load transfer from riser expansion to horizontal runs shall be given consideration when applying spring hangers. Spring Cushion Hangers may be used where vertical movement does not exceed 1/4 inch (6 mm), and where formal load and movement calculations are not required. Variable spring Hangers shall be used for all other resilient support requirements. Constant Support Hangers shall be used on piping systems where the deviation in supporting force must be limited to 6 percent and which cannot be accommodated by a Variable Spring Hanger. (Extracted from ANSI/MSS-SP69, 2003, Page 7, Section 7.4 and 7.4.1 to 7.4.3,

inclusive, with permission of the publisher, the Manufacturers Standardization Society.)

3.3 Hanger Spacing

.1 Refer to table below:

Size (Inch (mm))	Hanger Rod Diameter Inch (mm)	Maximum Support Centres		
		PVC Pipe (mm)	Copper Pipe (mm)	Steel Pipe (mm)
½ to 1 (12 to 25)	3/8 (10)	1,500	2,500	2,100
1½ to 2 (40 to 50)	1/2 (13)	2,000	-	2,500
2½ to 3 (65 to 80)	5/8 (16)	2,200	-	2,800
4 (100)	3/4 (19)	2,600	-	3,500
5 to 6 (125 to 150)	7/8 (22)	3,000	-	4,000
8 (200)	7/8 (22)	3,500	-	4,500
Above 10 (250)	7/8 (22)	3,800	-	5,500

.2 For calculated loads, rod diameters may be sized in accordance with MSS SP-58, Table 3 provided Table 1 and Section 73 of MSS SP-58 are satisfied.

.3 Rods may be reduced one size for double rod hangers. Minimum rod diameter shall be 3/8 inch (9.5 mm) (M10).

.4 Columns noted refer to Table 3.

.5 When practical, locate hangers immediately adjacent to any change of direction of pipe. Total length of pipe between supports less than three-fourths the full hanger span.

.6 In case of concentrated loads (such as valves, strainers and flow meters) the supports shall be placed as close as possible.

3.4 Anchors Guides and Restraints

.1 Anchors, guides and restraints shall be located by the Consultant responsible for piping design. Should the need or the desirability of relocating, eliminating or adding anchors, guides or restraints arise; such changes shall be brought to the attention of the Consultant for consideration and approval.

.2 Anchors, guides and restraints shall be designed for imposed loadings as determined by the Consultant. For guided systems, in the absence of specified lateral loads, the guide shall be designed for 30 percent of the dead weight load based on the spans listed in Table 3, with a design load of 50 Lb (0.22 kN) as a minimum.

.3 For pressure piping with joints not having a restraining design, other positive restraining means such as clamps, rods and/or thrust blocking shall be used to maintain the integrity of the joints.

.4 The necessity for, and the location of, shock suppressors and seismic control devices shall be as determined by the Contractor's Engineer responsible for seismic analysis.

.5 The location, type and number of corrective devices which may be necessary to control any unforeseen vibrations, as determined after the piping is in service, are not a part of this standard.

.6 Refer to MSS SP-127 for the design, selection, and application of the bracing piping systems subject to seismic - wind - dynamic loading.

.7 (Extracted from ANSI/MSS-SP69, 2003, Page 11, Section 13 and 13.1 to 10.6, inclusive, with permission of the publisher, the Manufacturers Standardization Society.)

3.5 Examination

.1 Do not begin installation until substrates have been properly prepared.

.2 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.6 Preparation

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.7 Hanger Installation

.1 Install in accordance with manufacturer's instructions.

.2 Clamps on Riser Piping:

.1 Support independent of connected horizontal pipe work using riser clamps and riser clamp lugs welded to riser.

.2 Bolt tightening torques shall be to industry standards.

.3 Steel Pipes: Clamp is fitted preferably below coupling or welded pipe lug.

.3 Use approved constant support type hangers where:

.1 For critical high temperature where vertical movement of pipe work is 1/2 inch (12.7 mm) or more.

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.4 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 percent of total load.

.5 Adjust hangers to equalize load.

.6 Support from Structural Members: Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

.7 Field welding of supports should be done by qualified welders using qualified welding procedures.

.8 Proper care and ventilation should be given when welding galvanized components.

.9 All hangers shall employ a lock nut arrangement.

3.8 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipe work from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is greater than 1/2 inch (12.7 mm), offset pipe hanger and support so that rod hanger is vertical in hot position.

3.9 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 Tighten all set screws and lock nuts.

.2 Hammer jaw firmly against underside of beam for Figure 127 only.

3.10 Protection

.1 Protect installed products until completion of project.

.2 Touch-up, repair or replace damaged products before Substantial Completion.

3.11 Coating

.1 All pipe support elements shall be coated. Submit coating system for review and approval.

END OF SECTION

Standard Specification Revision History:

Rev. No.	Date	By	Chk'd	Comment
0	05/05/2016	AKD	AMF	First Issue

Table of Contents

PART 1 GENERAL

1.1 Work Included

.1 This section includes all labour, materials and incidentals for supply and field-installation of piping insulation systems as shown on the Drawings and herein described.

.2 All process piping, process equipment, hot surfaces (above 60 °C) and cold surfaces that may condense with a dew point of 24 °C.

1.2 Work Excluded

.1 Sections specifically excluded in Section 01110.

.2 Vibration control devices.

.3 Pressure relief valves, rupture discs.

.4 Gauges.

.5 Flexible connectors.

1.3 Related Work

.1	Piping - Hot Water	Section 15098
.2	Valves - Hot Water	Section 15108
.3	Hangers and Supports	Section 15260

1.4 Quality Assurance and Reference Standards

.1 Work shall be carried out only by qualified tradesmen.

.2 Conform to all standard specifications referenced herein.

1.5 Submittals

.1 Submit manufacturers' literature and catalogue information for all materials and equipment.

1.6 Delivery, Storage and Handling

.1 Protect all materials and equipment from weather and from all damage.

1.7 Co-operation and Sequencing of Work

.1 Co-operate with all trades in scheduling work.

.2 Do not install insulation until piping has been completed, tested and accepted by the Owner.

PART 2 PRODUCTS

2.1 General

.1 Maximum Fire spread rating of 25 (CAN/ULC-S102-M).

.2 Maximum smoke spread rating of 50 (CAN/ULC-S102-M).

.3 Vapour barrier shall be maintained for chilled water and ambient service applications.

2.2 Insulation Type 1 – Formed Mineral Fibre

.1 Factory applied vapour barrier not required for hot water application

.2 Material in accordance to ASTM C 547.

.3 50 mm minimum thickness.

.4 Thermal conductivity shall not exceed 0.034 W/m °C when tested at 24 °C in accordance to ASTM C 335.

.5 Valves and flanges: Insulate valve bodies, flanges and unions with fitted oversized pipe covering, or mitred blocks to thickness of adjacent pipe covering. Drain and vent piping and valves shall be left uncovered.

.6 Fastening

.1 All insulation seams shall be fastened with aluminum fast setting self-adhesive tape.

.2 Tape width shall be 2 inches (50 mm) minimum.

2.3 Insulation Type 2 – Closed Cell Elastomeric

.1 Material in accordance to ASTM C 547.

.2 50 mm minimum thickness or average density of 80 kg/m^3.

.3 Thermal conductivity shall not exceed 0.039 W/m°C when tested at 24 °C in accordance to ASTM C 335.

.4 Molded, pre-slit and pre-glued longitudinal seam for small pipes.

.5 Manufacturer recommended products for closing seams when maintaining vapor barrier.

2.4 PVC Jacketing

.1 All pipe insulation on interior piping shall be covered with pre-formed PVC jacketing.

.2 Thickness shall be 0.3 mm minimum.

.3 Colour: white.

2.5 Aluminum Jacketing

.1 All pipe insulation on outside piping shall be covered with embossed aluminum cladding.

.2 Aluminum thickness shall be 0.6 mm minimum.

.3 Provide 50 mm laps on all seams. Only aluminum rivets or sheet metal screws are allowed for fastening.

.4 Mitered segments shall be provided for pipe elbows and fittings with sufficient overlap over seams.

2.6 Insulation Blanket

.1 Supply and install insulation blankets for all flanged piping components. All the following components (but not limited) shall be insulated using this product.

.1 Heat Exchangers (if not factory insulated).
.2 Pumps.
.3 Flow meters.
.4 Strainers.
.5 Expansion joints / compensators / threaded unions.
.6 Flanged valves.

.2 Insulation blankets shall be suitable for temperatures up to 120 °C.

.3 Insulation blankets shall facilitate easy removal and re-installation of the same blanket.

.4 Thermal conductivity shall not exceed 0.035 W/m °C when tested at 24 °C in accordance to ASTM C 335.

.5 Minimum insulation thickness is 25 mm.

PART 3 EXECUTION

3.1 General

.1 Follow supplier recommendations.

.2 Co-ordinate insulation with other trades.

.3 Do not install insulation until:

.1 Piping has been installed, tested and approved.
.2 Pipe surface is clean and dry.

3.2 Installation of Pipe Insulation

.1 Install insulation in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B and BC Insulation Contractors Association Manual, and according to manufacturer's instructions.

.2 Where necessary, for valves and custom fittings, shape insulation to suit and provide complete coverage.

.3 Field cut insulation for fittings and appurtenances.

.4 Install jacketing over all insulation. Cut and shape to suit insulation as required. Fasten jacketing with stainless steel straps at a maximum spacing of 300 mm.

Ensure joint is at bottom of pipe and arranged to prevent ingress of water. Seal joint.

.5 Steel pipe cover protective saddle (Type 39) and protective shield (Type 40) shall be installed at all pipe support locations in accordance to MSS-SP58 Section 9. Insulation inserts can be utilized when maintaining vapour barrier with Engineers pre-approval.

.6 For chilled water application, vapour barrier shall be maintained.

END OF SECTION

Standard Specification Revision History:

Rev. No.	Date	By	Chk'd	Comment
0	05/05/2016	AKD	AMF	First Issue
1	04/04/2018	AMF		As marked

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PART 1 GENERAL

1.1 Background

.1 This section refers to those portions of the work that are unique to the requirements for flushing, cleaning and passivating installed process piping.

.2 Hydrostatic testing shall be completed prior to commencing pipe conditioning.

.3 All pipes shall be flushed, cleaned and passivated prior to the commencement of any commissioning.

.4 Flushing refers to circulation of water with the objective to remove solids that in process water suspension have the potential to cause damage to instrumentation and/or equipment or deposit and foul equipment.

.5 Cleaning refers to the circulation of chemical cleaners to remove grease and petroleum products, and iron oxides from the interior of piping systems.

.6 Passivation refers to pipe treatment by circulation of a chemical to cause the deposit of a non-reactive scale and corrosion inhibitor film on the internal surface of the pipe.

.7 All water quality testing associated with the pipe conditioning will be at the Contractor's expense.

.8 Contractor to obtain any permits required for drainage / disposal generated during the pipe conditioning process.

1.2 Related Work

.1	Piping	Section 15098
.2	Piping Specification Sheets	Section 15099

1.3 References

.1 This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.4 Submittals

.1 Provide data sheets, including safety and first aid data, for all chemicals.

.2 Provide information on chemicals to demonstrate the non-toxicity of the blow down water and environmental acceptability.

.3 Submit detailed procedure and concentration calculations for the determination of chemical feed rate.

.4 Submit hydraulic calculations for every step for all branches showing what velocity will be achieved. Submit pump curve with calculations.

.5 Submit schematic of system showing any temporary bypass connections to be used during flushing and chemical circulation, the location of the pump, and fill and drain connection locations.

.6 Provide detailed drawings of any branches that will be manually cleaned if cleaning and/or flushing is not possible due to configuration.

.7 Provide detailed drawings of temporary pipe routing that is required to complete pipe conditioning to the requirements specified herein.

.8 Provide temporary pump and strainer data sheets.

.9 Submit a report at the end for the water quality that shall include but not limited to:

.1 TDS

.2 TSS

.3 pH

.4 Iron ppm

.5 Corrosion inhibitor ppm

1.5 Scheduling of Work

.1 Schedule work to minimize interruptions to existing services.

PART 2 PRODUCTS

2.1 Chemicals

.1 All chemicals required for pipe conditioning shall be supplied by the Contractor.

.2 Chemicals shall be selected to achieve suitable cleaning and passivation of the piping system.

.3 All chemicals shall be non-foaming and acceptable to the environment.

2.2 Equipment

.1 The Contractor shall be responsible for the supply, installation and removal of all temporary piping, hoses and appurtenances to complete the requirements of pipe conditioning specified herein.

.2 The Contractor shall provide all equipment required to complete pipe conditioning as specified, including but not limited to pumps, strainers, compressor, hose and manual cleaning tools.

PART 3 EXECUTION

3.1 General

.1 Contractor shall arrange for the assistance and supervision of the Chemical Supplier during pipe conditioning. A supplier representative shall be present on site during flushing, cleaning, and passivation.

.2 The Chemical Supplier shall review the method proposed for pipe conditioning and provide comments prior to approval by the Engineer.

.3 Prior to proceeding to the next step of conditioning the Chemical Supplier must confirm satisfactory results of water analysis.

.4 Upon pipe conditioning completion, the Chemical Supplier is to submit a report confirming the condition of the piping network and the proper execution of the chemical cleaning and passivation.

3.2 Manual Cleaning

.1 Manual cleaning shall be completed for any piping section that cannot be flushed and/or cleaned as a result of configuration. Steel particulates and other solid contaminants shall be removed.

.2 Manual cleaning shall be accomplished by scrubbing the internal surface of the piping.

.3 Final cleaning shall be completed with compressed air.

.4 All piping that has been manually cleaned shall be visually inspected and tagged. Any tagged pipe cannot be further processed (e.g. welding).

.5 Any piping section that cannot undergo the chemical cleaning step as per Section 3.4 shall be filled with diluted chemical as per supplier recommendation for 24 hours.

3.3 Flushing

.1 Contractor to ensure all heat exchangers, equipment and instrumentation are bypassed or replaced by a spool piece.

.2 It is the responsibility of the Contractor to supply temporary means to determine flow/speed at the pump.

.3 Contractor shall supply a temporary strainer with a 3 mm screen and 30 mesh.

.4 Install all temporary piping, hoses and appurtenances to complete the requirements of flushing.

.5 Fill the system with potable quality water and circulate the water to ensure a minimum of five (5) complete cycles of water at any location in the system. System shall be flushed at the water velocity of 2.0 m/s.

.6 Flushing shall be done in a sequence in accordance with the hydraulic calculations submitted to allow circulation of water in all pipes of the system and ensure smaller pipes are flushed first.

.7 Drain the system and refill with clean potable water. Refilling shall be in accordance with section 3.4 below

.8 Retain a sample of the water for testing.

3.4 Cleaning

.1 Contractor to ensure all heat exchangers, equipment and instrumentation are bypassed or replaced by a spool piece.

.2 It is the responsibility of the Contractor to supply temporary means to determine flow/speed at the pump.

.3 Contractor shall supply a temporary strainer with a 4 mm screen and 30 mesh.

.4 Add the cleaning agent in the water at the specified concentration level and as per recommendation of Chemical Supplier. Chemical shall be injected in a sequence that will allow proper mixing to achieve the ppm requirements for this step.

.5 The cleaning mixture shall be circulated for a minimum of 48 hours or as required by Chemical Supplier for all pipe sections. Flow velocity of the cleaning mixture shall be maintain flow turbulence for proper mixing

.6 Purge the system with clean potable water.

.7 Repeat steps 4 to 6 as many times as required by Chemical Supplier.

.8 Retain a sample of the water for testing.

3.5 Passivation

.1 Add chemical treatment in the water at the specified concentration level and as per recommendation of Chemical Supplier. Chemical shall be injected in a sequence that will allow proper mixing to achieve the ppm requirements for this step.

.2 The chemical treatment shall be circulated for 24 hours or as required by Chemical Supplier. Flow velocity of the chemical treatment shall be maintain flow turbulence for proper mixing.

.3 It is the responsibility of the Contractor to achieve an iron content of 1.0 ppm at this point. If it cannot be achieved by bleeding and increasing the chemical concentration, the Contractor must repeat the pipe condition procedure.

.4 Retain a sample of the final water for testing.

.5 Once the passivation is completed, the concentration of chemicals within the piping system shall be brought to the normal plant operation. The pipes shall be maintained full of water, and a circulation of at least one complete cycle of water at any location in the system shall be done 2 times per week.

3.6 Nitrogen Blanket (Optional)

.1 After the owner representative deems the pipe conditioning complete, the all water shall be drained as per local code requirements.

.2 The air shall be purged to the Consultant's satisfaction using nitrogen.

.3 Nitrogen pressure to be maintained at 10 psi.

.4 Contractor shall supply and install a pressure gauge and a valve arrangement with a nitrogen filling connection and nitrogen cylinder in one building as directed by the Consultant.

END OF SECTION

Standard Specification Revision History:

Rev. No.	Date	By	Chk'd	Comment
0	June 19, 2017	AV	SG	Approved for use.

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PART 1 GENERAL

1.1 Codes and References

.1 The following publications shall govern all work related to this project:

.1 CSA C22.1, Canadian Electrical Code, Part 1 (Current Edition), Safety Standard for Electrical Installations.

.2 BC Building Code.

1.2 Units

.1 The Contractor shall follow the SI metric system for all submissions and correspondence.

1.3 Authorities Having Jurisdiction

.1 Refer to Section 01110.

1.4 Drawings and Specifications

.1 Contract drawings for Electrical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement of equipment and wiring. Care shall be taken to ensure that the installation is in accordance with detailed drawings, where provided, and that the installation meets all code requirements.

.2 It is intended that the specifications and drawings cover the complete electrical and controls installation ready for continuous operation. Consequently, minor details not necessarily shown or described in the contract documents, but necessary for the proper functioning of the installation shall be included, and be in the Contractor's estimate.

1.5 Work Included

.1 Refer to Section 01110.

1.6 Work Not Included

.1 Refer to Section 01110.

1.7 Related Work

.1 General Requirements – Divisions 0 and 1.

.2 Mechanical – Division 15.

1.8 Owner Supplied Equipment and Materials

.1 The Contractor shall accept all Owner supplied equipment and materials within 48 hours of a request to do so by the Owner. The Contractor shall inspect same prior

to acceptance and any loss or damage after acceptance shall be made good at no cost to the Owner.

.2 Refer to Section 01110.

1.9 Shop Drawings

.1 Submit shop drawings to the Engineer for approval.

.2 Shop drawings shall include catalogue sheets, manufacturer's bulletins, wiring diagrams, dimensional data and operating descriptions of all items supplied.

.3 Shop drawings shall show piping, accessories, duct work, and other items that must be shown to ensure co-ordinated installation.

.4 Shop drawings shall include instrumentation loop diagrams and interconnection diagrams showing terminal and wire numbers, number of conductors between components and requirements of interwiring conductors. This shall include any requirements for shielding and twisting of pairs.

.5 Shop drawings shall indicate clearances required around equipment for proper operation and maintenance.

.6 The Engineer will check shop drawings. Approval of shop drawings does not relieve the Contractor from the requirement to provide equipment and systems in accordance with this specification and the contract drawings.

.7 The Contractor shall also check manufacturer’s shop drawings. They shall ensure that the drawings and equipment meet the requirements of this specification.

1.10 Record Drawings

.1 Maintain Record Drawings according to Division 1 specifications.

.2 Maintain one (1) set of white prints on jobsite for recording of field changes to conduit runs, equipment locations, etc. Record Drawing markups shall be done daily. Deliver drawing set to Engineer at job completion.

.3 Record Drawing markups shall be to the same standard and detail as the contract drawings. Markups shall be to scale, or dimensions shall be noted. They shall show all changes made by the Engineer, Owner and Contractor.

.4 The Contractor shall submit record drawings to the Engineer for inspection, when the Engineer is on site to inspect the Contractor's work.

.5 If the Engineer finds that the final record drawings do not accurately reflect the work done, the Engineer shall return them to the Contractor for revision. If the Contractor does not resubmit adequate and correct drawings within 7 days, the Engineer will mark up record prints to final and correct state. The Engineer’s cost for this work will be deducted from the Contractor's final payment.

1.11 Maintenance and Operating Manuals, Spare Parts Lists

.1 Four (4) copies of the manufacturer's maintenance instructions, operating manuals and spare parts lists shall be supplied by the Contractor to the Engineer on job completion showing each major piece of electrical equipment and/or equipment as designated by the Engineer. Instructions shall be complete with installation, operating and maintenance drawings and shall include one (1) corrected copy of all shop drawings. Catalog details of all equipment actually installed, including schematic drawings layouts and maintenance data as applicable shall be included in the maintenance instructions.

.2 All four (4) copies of maintenance instructions and operating manuals shall be bound in separate hard back cover folders, complete with index and tabs.

1.12 Guarantee

.1 The Contractor shall guarantee their work, equipment and materials supplied for a period of one year after final completion. They shall repair, replace or otherwise make good any part or all of the electrical installation should any failure, malfunction or deficiency becomes known during that period. This work shall be done at no cost to the Owner.

1.13 Discrepancies and Omissions

.1 If the Contractor is in doubt as to the meaning of the specifications or bid documents, or finds omissions or discrepancies therein, they shall submit a request for interpretation or correction thereof to the Owner. If discrepancies are not clarified the more stringent specification shall be applied.

PART 2 PRODUCTS

2.1 Materials and Equipment

.1 Provide new and CSA approved equipment, free of defects and approved for electrical installations. Factory seconds will not be accepted. Equipment shall carry an approval label; labels shall be clearly visible and legible after equipment is installed.

.2 Other agencies, acceptable to the BC Safety Authority, will be considered as equal to CSA. They include:

.1 CGA -Canadian Gas Association;

.2 ULC -Underwriter Laboratories of Canada;

.3 ITS - Intertek Testing Services NA Ltd., (ITS - Canadian Divisions) formerly Warnock Hersey Professional Services Ltd. (label is still a stylized WH);

.4 ETL - Intertek Testing Services NA Inc., (ITS - US Division) formerly ETL Testing Laboratories (label is still ETL);

.5 cUL - Underwriters Laboratories Inc.; and

.6 cMET -MET Laboratories Inc.

The above labels should be affixed to the various components within a control panel, and the control panel itself shall have an approval label.

If approval labels are missing the Contractor shall arrange for the BC Safety Authority to inspect and approve (usually at the job site) the equipment, under the SPECIAL INSPECTION PROGRAM. All costs shall be borne by the Contractor.

.3 Install all materials and equipment in accordance with the manufacturer's recommendations.

.4 All equipment and systems shall meet WorkSafe BC (WSBC) requirements.

.5 Provide WHMIS data sheets on all equipment and material, where required by WSBC.

2.2 Equals and Substitutions

.1 Where equipment and materials is specified by manufacturer, "or approved equal" is implied unless specifically noted otherwise. Submit full technical data with request for approval of equals, a minimum of 5 days prior to tender closing.

.2 Contractors who supply approved equals shall furnish revised wiring and mounting details where required. The Contractor shall pay for all additional Engineering costs related to installation of substituted equipment.

.3 Record Drawings shall show the revised wiring, mounting and other details.

PART 3 EXECUTION

3.1 General

.1 Ensure 1,000 mm (minimum) clearance (working space) in front of all electrical panels and equipment.

.2 Check all electrical equipment to ensure that the breakers and fuses, and conductors are sized in accordance with Canadian Electrical Code requirements.

.3 Arrange wiring and apparatus to conform to architectural and structural details, in an approved manner.

3.2 Site Inspection

.1 Examine construction site prior to submitting tender and ascertain all conditions affecting work. Base tender on site conditions. Advise Engineer of any potential problems observed during the site visit, within 24 hours of visit.

3.3 Permits, Licences and Fees

.1 Submit drawings to all inspection authorities for approval.

.2 Apply and pay for all required permits, licences and fees. Supply inspection certificates to the Owner at the end of the job. Work shall not be considered complete until these certificates are submitted to the Owner.

3.4 Safety

.1 Contractor shall be responsible for the safety of all personnel, theirs and others, working on the electrical equipment.

.2 Contractor shall establish lock-out procedures and enforce these procedures.

.3 Contractor shall provide training and instruction as required for all their personnel, and others working on the electrical and controls equipment.

.4 Contractor shall obtain assistance from outside agencies or specialists, where required, to insure a safe operating workplace.

.5 The workplace shall be kept neat and tidy during construction. Tools will not be left exposed while not in use, and material shall not be allowed to accumulate in the work area.

3.5 Excavation, Backfill, Cutting and Patching

.1 All excavation, backfill, cutting and patching required for the electrical installation, will be by the General Contractor.

3.6 Equipment Identification

.1 All field components shall be clearly labelled with 3 mm thick lamicoid labels. Labels shall have minimum 3 mm white letters on black background. Dymo tape labels are not acceptable. Submit nameplate list for approval with shop drawings.

3.7 Conduit and Cable Identification

.1 All conduits and cables - power and control, shall be clearly identified with tag numbers as indicated on the drawings. Provide Electrovert "strap-on S markers" or T&B Tyrap or Raychem TM3 identification cable ties with indelible marking.

3.8 Testing

.1 All electrical power, control and alarm systems shall be tested and calibrated by the Contractor to ensure that they are operating in accordance with the intent of the drawings and specifications. If the Contractor is in doubt as to the intent they shall obtain clarification prior to tender closing.

.2 The Contractor shall supply all necessary instruments, meters, equipment and qualified personnel to make tests on electrical and control equipment and wiring during construction or after installation when requested by the Engineer.

The tests shall include:

.1 Insulation resistance tests in accordance with the Canadian Electrical Code before energization of any circuits or equipment.

.2 All tests as recommended in manufacturer's instructions.

.3 Tests of adequacy of grounding system and connections.

.4 Complete functional test of all electrical and control systems.

Where tests are optional, they shall be presumed to be included unless this is highlighted in the tender, and approval to delete the tests in question has been given.

.3 The Contractor shall troubleshoot and replace all defective equipment, systems and wiring discovered during their testing program. They shall retain such competent personnel, suppliers, representatives or subcontractors as necessary to complete this work. They shall retest all systems where remedial action was necessary. After they are completely satisfied that everything is completely operational they shall inform the Engineer that they are ready for start-up.

3.9 Start-up

.1 The Contractor shall completely test and demonstrate the system to the satisfaction of the Engineer. This test shall include but not be limited by the generality of the following:

.1 Instrumentation:

.1 All setpoints;

.2 All Operator Interface functions;

.3 All control functions;

.4 All pressure readings;

.5 All temperature readings;

.6 All flow readings; and

.7 All energy meter functions.

3.10 Start-up Co-ordination

.1 The Contractor shall co-ordinate the startup of the facilities in co-operation with the Owner, Engineer, other contractors on site and the various vender representatives on site.

3.11 Making Good

.1 The Contractor shall make good any damage or destruction caused by him to the structures and equipment or work of other trades on this project.

3.12 Protection of Work

.1 The Contractor shall properly cover and protect from damage and weather, all equipment and material related to his/her work.

3.13 Clean-Up

.1 Upon completion of the work, the Contractor shall remove all tools, debris, and surplus material, and shall leave the area neat and clean to the Engineer's satisfaction.

3.14 Co-ordination

.1 The Contractor shall co-ordinate the supply of information between all suppliers and manufacturers of electrical equipment to insure that electricians in the field have correct and adequate information to install all equipment.

3.15 Workmanship

.1 Work shall be done in accordance with good practice and by tradesmen accredited and skilled in the performance of electrical work.

.2 The Engineer shall determine whether workmanship is acceptable. Work approved by the Electrical Inspector or other authorities may still be rejected by the Engineer.

.3 Grounds for rejection shall be any one of, but not limited by the following:

.1 Poor appearance;

.2 Poor quality materials;

.3 Conduit or wiring connections incompatible with standard of enclosures used;

.4 Insufficient support or fastenings; and/or

.5 Materials installed in a manner or location that will impede other trades or make future maintenance awkward, costly or impossible.

3.16 Supplier Responsibilities

.1 The Contractor shall be responsible for ensuring that all their suppliers of equipment and material have sufficient information to determine whether their equipment and material is suitable for the intended use described in these documents.

.2 The Contractor shall notify their suppliers as follows:

.1 All suppliers shall ensure their equipment and material is suitable for the installation intended. If his/her equipment is found to be deficient, it shall be removed and replaced with suitable equipment, all at no cost to the Owner.

.2 The supplier shall ensure when applying for "equal" status to specified equipment, that his/her equipment is truly equal. If his/her equipment is discovered to be deficient in this respect, it shall be removed and the specified equipment supplied, all at no cost to the Owner or Engineer.

3.17 Seismic Restraint

.1 The Contractor shall provide seismic restraint for all wall mounted equipment. Wall mounted equipment shall be firmly bolted to wall brackets. Supports, anchors and

bracing shall prevent horizontal movement or tipping of wall mounted equipment during and after earthquakes.

3.18 Inspection of Work

.1 On this project the Electrical Engineer, Owner and Electrical Safety Branch will be inspecting electrical work at various stages of construction.

.2 Provide minimum two weeks advance notice of request for substantial completion and final inspection.

3.19 Alternatives

.1 Bidders are encouraged to make alternative proposals where they feel that an alternative would be of advantage to the Owner.

3.20 Equipment Delivery

.1 Coordinate equipment delivery with other trades.

.2 The Contractor is responsible for the following work under this contract:

.1 Inspection and acceptance of equipment at time of delivery;

.2 Report all visible damage to the contract administrator immediately;

.3 Transport equipment from off-loading point to Owner's designated storage area; and

.4 Track all received equipment.

END OF SECTION

Standard Specification Revision History:

Rev. No.	Date	By	Chk'd	Comment
0	June 19, 2017	AV	SG	Approved for use.

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PART 1 GENERAL

1.1 Wiring Method

.1 Wiring method shall be surface run conduit and wire, and Teck cable.

.2 Interior control panel wiring shall be "TY-RAP'ed" bundles, secured to rear mounting panel, or installed in "Panduit" type wiring trough.

.3 The Contractor is permitted to use cable tray, in conjunction with .1, where this wiring method is deemed to be advantageous.

1.2 Ground Conductor

.1 Provide separate ground conductor in all non-metallic conduit.

PART 2 PRODUCTS

2.1 Conduit

.1 Provide galvanized steel electrometallic tubing (EMT). EMT shall be installed with watertight fittings for outdoor applications.

.2 Provide rigid PVC conduit CSA 22.2 No. 211.2-06 (R2016) where rigid PVC is surface run. Use approved jointing cement. Run ground conductor.

.3 Provide rigid hot dipped galvanized steel in areas where exposed to mechanical damage.

.4 Areas where conduit is exposed to mechanical damage are as follows:

.1 Surface mounted outdoors, from 600 mm below ground to 1,600 mm above ground, and

.2 Stubbed up through floors.

.5 Provide minimum 21 mm diameter conduits unless noted otherwise.

.6 Provide flexible conduit for last 500 mm of connection to valve actuators, pressure switches and similar devices.

2.2 Flexible Conduit

.1 Flexible conduit shall be Hydrotite or Sealtight with extruded PVC Jacket.

.2 Non-metallic flexible conduit is acceptable.

2.3 Wire

.1 Provide stranded copper conductor unless otherwise noted.

.2 Provide solid copper conductor for power circuits.

.3 Provide #16AWG extra flexible stranded switchboard wire for all control panel wiring.

.4 Provide minimum #12AWG for power circuits.

.5 Provide RW90 X-LINK polyethylene insulated wire.

.6 Wiring at 120/240 Volts shall be 300 Volt insulated.

2.4 Teck Cable

.1 Teck cable shall be aluminum armoured copper conductor with X-link insulation complete with fire retardant PVC jacket overall.

.2 Provide appropriately sized PVC duct in concrete for Teck cable entrances to buildings. Seal with duct seal.

2.1 Instrumentation Cable

.1 Provide shielded twisted pairs with individual and overall shields.

2.2 Cable Tray (if used)

.1 Provide aluminum cable ladder with 300 mm rung spacing, supported in accordance with manufacturer's recommendations. Size tray in accordance with the CEC.

.2 Provide factory fabricated tee, elbow, angle and special fittings as required.

.3 Provide a barrier between instrument cable and other cable.

2.3 Connectors

.1 Teck connectors shall be raintight. Provide Thomas & Betts "Spin On Series II" connectors.

.2 EMT connectors shall be bushed steel.

.3 Connectors shall match the EEMAC standard of the box, fitting or enclosure they enter.

2.4 Waterstop Sealant

.1 Provide GE RTV 108 general purpose silicone rubber adhesive sealant.

2.5 Duct Seal

.1 Provide Iberville Duct Sealant DUCT-1.

2.6 Flame Stop Sealant

.1 Provide Thomas & Betts flame-safe firestop compound.

2.7 Junction Boxes

.1 Provide hinged NEMA 4 enclosures with latching door mechanisms or screw-on covers. Enclosures shall be steel, phosphatized and finished with a recoatable

powder inside and out of ANSI 61 smooth Gray. Enclosures shall be complete with back panel and terminal blocks as necessary to make all connections within.

.2 Junction boxes with multiple voltages within shall be provided with partitions to maintain separation of control wiring and 120V wiring.

.3 Enclosures shall be sized as required for conduit/cable entry, all equipment contained therein, plus adequate hand/working space.

.4 Mount all junction boxes securely. Where a surface is not flat, unistrut shall be used for spacing and support to allow the box to be installed without stressing its structure.

PART 3 EXECUTION

3.1 Conduit

.1 Exposed conduit shall be parallel or perpendicular to building lines.

.2 Provide expansion joints where required.

.3 Provide thermal breaks where required.

.4 Support conduit to eliminate visible deflection.

.5 Conduit installed in areas where building finish is painted, shall be painted to match, with two coats of same colour, type and quality.

.6 Conduit entering, or passing through an electrical enclosure shall have locknut and washer on both sides of the enclosure. Connection shall be to the standard of the enclosure.

.7 Holes in enclosures, for conduits or cables, shall be made with a knockout.

.8 Seal with fire stop sealant all points where wiring or conduit passes through fire separations.

.9 Flexible conduit shall only be used where flexibility is required for future equipment changes or small equipment movement.

3.2 Cable Tray (if used)

.1 Install tray after ducting, piping (etc.) has been installed.

.2 Cable trays shall terminate within 600 mm of serviced equipment.

.3 Suspend cable tray with minimum 3/8” ready rod. Attach to concrete ceiling with Hilti drop in anchors. Install as per manufacturer’s recommendation.

.4 Provide seismic restraint in accordance with the Electrical Contractors Association of B.C. Seismic Restraint Manual.

.5 24V cable shall be separated from others by a barrier.

.6 Ensure all cable tray is grounded/bonded in accordance with CEC requirements.

3.3 Waterstop Sealant Installation

.1 After all instruments and control systems have been successfully tested, seal all conduits that exit the ETS room.

.2 Apply with pump or gun.

3.4 Wiring Identification

.1 Control Panel Wiring shall be as follows:

.1 Identify wiring at each end with tubular markers. Wiring identification numbers shall match terminal numbers.

.2 Install insulated crimp-on type ferrules at each end of each wire.

.3 Provide wire numbers for all wires and terminals where numbers are not designated.

.4 Colour code wiring "Red" for 120 VAC;
"Blue" for 24 VDC; and
"Yellow" for 12 VDC.

.2 Power wiring shall be as follows:

.1 Identify wiring at each end with tubular markers. Identification numbers shall match terminal numbers.

.3 Use colour-coded wires in instrumentation and communication cables, matched throughout the system.

3.5 Spare Conductors

.1 Unused wiring in conduits or cables shall be clearly identified as spare with each conductor numbered individually.

3.6 Instrumentation Cable

.1 Ground shield at one location, unless recommended otherwise by the equipment supplier.

.2 Test continuity of shield prior to connecting instruments.

.3 Fit clear plastic tubing over shield drain wires.

.4 Where the shield is not grounded, double back and fit heat shrink tubing to secure the shield to the respective pair and prevent connection to ground. Do not cut back to cable termination.

.5 Install insulated crimp-on type ferrules on each end of each wire, including shield (where grounded).

.6 Terminate armour in an approved connector.

3.7 Equipment Mounting

.1 Use 19mm good one side (G1S), exterior grade plywood where required to mount electrical equipment on walls.

.2 Paint plywood with three coats minimum, one primer and two of the base colour. Base colour shall match the surrounding wall or be white if the wall is unpainted.

3.8 Wiring Terminations

.1 Ensure lugs, terminals and screws used for termination of wiring are suitable for copper or aluminum conductors.

3.9 Grounding and Bonding

.1 Ensure that all metal components and equipment are grounded and/or bonded in accordance with the Canadian Electrical Code.

3.10 Supports

.1 Where inserts are required in concrete, expansion inserts, lead inserts, and plastic inserts shall be used in drilled holes. Shot driven pins may be used in structural concrete only with permission from the Engineer.

END OF SECTION

Standard Specification Revision History:

Rev. No.	Date	By	Chk'd	Comment
0	June 19, 2017	AV	SG	Approved for use.

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PART 1 GENERAL

1.1 General Requirements

.1 All work shall be performed by qualified tradesmen working for a reputable Contracting company experienced in this type of work and shall be strictly in accordance with the best commercial practice.

.2 Supply all relevant materials, tools and labour to complete all work outlined below.

.3 All electrical work shall be performed by a qualified Registered Electrical and Inspection Contractor as defined in the British Columbia Safety Standards Act.

1.2 Reference Codes

.1 Work shall be done in accordance with the latest versions of the following:

.1 BC Building Code.

.2 CSA Canadian Electrical Code.

1.3 Work Included

.1 Provide electrical power to the ETS control panel. The ETS control panel shall be fed from the closest distribution panel or location as provided by the Base Building.

PART 2 PRODUCTS

2.1 ETS Control Panel Feeder

.1 Provide a circuit breaker with required number of poles and rating, and compatible with the closest distribution panel to the ETS.

.2 Provide required number of feeder conductors of required ampacity in appropriately sized EMT conduit or Teck cable.

.3 Provide brushed steel EMT connectors, or Teck connectors in accordance with EEMAC standard of the enclosures they enter.

2.2 Bonding Connections

.1 Provide Burndy Hyground compression fittings for bonding the ETS to the building grounding system.

.2 Provide bonding conductor sized according to the Canadian Electrical Code.

PART 3 EXECUTION

3.1 Conduit

.1 Exposed conduit shall be parallel or perpendicular to building lines.

.2 Provide expansion joints where required.

.3 Support conduit or Teck cable to eliminate visible deflection.

.4 Conduit installed in areas where building finish is painted, shall be painted to match, with two coats of same colour, type and quality.

.5 Conduit entering, or passing through an electrical enclosure shall have locknut and washer on both sides of the enclosure. Connection shall be to standard of the enclosure.

.6 Holes in enclosures, for conduit, shall be made with a knockout.

END OF SECTION

Standard Specification Revision History:

Rev. No.	Date	By	Chk'd	Comment
0	June 19, 2017	AV	SG	Approved for use.
1	June 07, 2018	SG	SG	Approved for use(no flow switch).

Table of Contents

PART 1 GENERAL

1.1 General Requirements

.1 Unless specifically stated otherwise, all equipment covered by this Section shall be suitable for operation in buildings or enclosures with an ambient temperature as noted in Section 01110.

.2 All devices shall be designed for continuous operation.

.3 Provide, except where otherwise specified, the materials of construction necessary for satisfactory operation on the electrical service specified. Any changes from specified materials must be approved in writing.

.4 All instruments shall be factory calibrated to values stated in the documents, or as determined from process requirements.

.5 All instruments and devices on panel fronts and all devices in the panel rear shall be identified by a legend plate or nameplate.

.6 Finish shall be manufacturer's standard, but must include a prime coat and two finish coats.

.7 All process equipment packages which include control devices must provide interconnection and termination systems between all devices and equipment of the Contractor's supply. This shall include, but not be limited to interconnecting tubing, piping and fittings, terminal strips for field connections, bulkhead plates for cable and piping terminations, any local controls, block or isolation valves and all other control accessories as would normally be required for such an installation. Such installations must comply with applicable codes of good practice to ensure sound, reliable operation when installed. The supplier shall provide detailed installation instructions to the Contractor. This shall include wiring drawings and mechanical drawings showing equipment installation in piping.

.8 The Contractor shall provide complete sets of internal and external wiring diagrams, trouble-shooting data and calibration manuals for each device supplied.

.9 All instruments shall include a 12 month supply of consumables. Spare fuses and lamps shall be shipped with control panels. Supply not less than six of each type used in the panels.

.10 All instruments requiring AC power supply shall be for 120 Volts, 1 phase, 60 Hz.

1.2 Related Sections

.1	General Provisions	Section 16010
.2	Basic Materials	Section 16100

1.3 Design Conditions

.1 Refer to Section 01110.

PART 2 PRODUCTS

2.1 General

.1 Refer to Part 5 for controls components schedule and specific requirements.

.2 Refer to Design Conditions in Part 1.

2.2 Uninterruptable Power Supply (UPS)

.1 The ETS Control Panel shall be powered by means of a Double Conversion On-Line UPS.

.2 Provide a UPS with dry contact relay outputs connected to PLC inputs in the ETS Control Panel. The UPS relay outputs shall indicate the following conditions:

.1 UPS on Batteries, and

.2 UPS Fault.

.3 Provide a UPS capable of powering the ETS Control Panel for minimum 2 hours.

2.3 ETS Control Panel

.1 The Control Panel(s) shall be assembled in a CSA approved panel shop. Shop drawings for the Control Panel(s) must be approved by the Engineer prior to manufacture.

.2 The Control Panel shall contain the following components as required:

.1 Terminal blocks (including 10% spare) complete with DIN mounting rail and all necessary accessories.

.2 Wiring channel with removable covers i.e.: “Panduit”.

.3 DIN rail mountable control circuit breakers and/or fused terminal blocks.

.4 Copper grounding bus located at the bottom of the enclosure.

.5 24 VDC power supply with 25% over-capacity.

.6 4 port (minimum) Ethernet switch complete with one (1) fibre port (minimum).

.7 All DC and instrument wiring shall be shielded.

.8 Control relays with 120 VAC operating coils; contact ratings shall be sized accordingly.

.9 Timer relays; preferably OMRON.

.10 Heavy duty oil-tight switches, pushbuttons and pilot lights mounted in the control panel door(s). Pilot lights shall have LED lamps and be push-to-test. All devices shall have a lamicoid nameplate.

.11 Drawing pocket mounted on the inside of the Control Panel door.

.12 Controller (PLC) complete with analog and digital inputs and outputs (I/O). Discrete outputs shall be isolated dry contact type. Analog I/O shall be

compatible with 4-20 mA control signals. Provide sufficient I/O for current purposes plus 10% spare for future use.

.13 Graphical Operator Interface (OI) Panel capable of displaying equipment status and process values, and accept manual input for setpoint changes. The OI shall have alarming, data logging and trending capabilities.

.14 The Control Panel shall be NEMA 12 rated and shall have a suitable door latching mechanism and removable back-pan.

.15 Size the enclosure to allow for future equipment installation.

2.4 ETS Control System (ECS)

.1 The ECS shall be capable of communicating with and powering (where applicable) all instruments and energy meter(s) within the ETS.

.2 The ECS shall be capable of communicating with a central monitoring facility.

2.5 Pressure Transmitters (PT)

.1 Provide pressure transmitters to include the following general characteristics:

.1 Material of construction of all wetted parts shall be SS 316.
.2 Voltage surge protection.
.3 Over pressure protection to 1.5 of the design pressure.
.4 Stainless steel data plate to indicate instrument number.
.5 ½" NPT process connectors.
.6 NEMA 4 enclosure.
.7 Operator zero and span adjustment. Capability of adjusting zero span positively or negatively.
.8 Remote configuration feature.

.2 Input and Output characteristics shall be as follows:

.1 Supply voltage of 24 volts DC (loop powered).
.2 4 to 20mA output.

.3 Accuracy limits shall be as follows:

.1 Accuracy to ± 0.5% of calibrated span including the combined effect of repeatability and hysteresis.
.2 Drift (over six months) less than ± 0.3% of calibrated span.
.3 Drift (due to temperature) less than ± 0.5% of calibrated span.

.4 Standard of Acceptance:
.1 ABB.
.2 Endress – Hauser.
.3 Rosemount.
.4 Setra.
.5 Approved equal.

.5 Option: the Contractor is invited to submit an optional price for commercial grade pressure transmitters. Option subject to review and approval by the Owner and the Engineer.

.1 Contractor responsible to provide gauge siphon if required for the selected pressure transmitter.

2.6 Differential Pressure Transmitter (DPT)

.1 Material of construction of all wetted parts shall be SS 316.

.2 Voltage surge protection.

.3 Over pressure protection to 1.5 of the design pressure.

.4 Diaphragm isolation with adjustable internal damping.

.5 NEMA 4 enclosure.

.6 Operator zero and span adjustment.

.7 Stainless steel data plate to indicate instrument number.

.8 Input and Output characteristics shall be as follows:

.1 Supply voltage of 24 volts DC (loop powered).
.2 4 to 20mA output.

.9 Accuracy limits shall be as follows:

.10 Accuracy to ± 0.5% of calibrated span.

.11 Standard of Acceptance:
.1 ABB.
.2 Endress – Hauser.
.3 Rosemount.
.4 Approved equal.

2.7 Temperature Transmitter (TT)

.1 Provide 3-wire Resistive Temperature Detector (RTD) probe as follows:

.1 316 stainless steel sheath spring loaded RTD probe compatible with Contractor supplied thermowells extending to 40% - 60% of the service pipe diameter.
.2 ¾” NPT 316 SS tapered thermowell with a 2” extension for pipe insulation
.3 NEMA 4 enclosure.

.2 Accuracy limits shall be as follows:

.1 Accuracy, repeatability and linearity to ± 0.25% of calibrated span.
.2 Transmitter calibrated for 3 wire PT 100 ohm platinum RTD input.
.3 4 - 20mA (loop powered, 24VDC) isolated output.

.3 Stainless steel data plate to indicate instrument number

.4 Standard of Acceptance:
.1 ABB.
.2 Endress – Hauser.
.3 Approved equal.

.5 Option: the Contractor is invited to submit an optional price for commercial grade temperature transmitters. Option subject to review and approval by the Owner and the Engineer.

2.8 Control Valve (CV)

.1 Control valves shall be globe modulating type.

.2 Equal percentage flow characteristics.

.3 Flanges shall be ANSI Class 150 or 300 RF flange ends with drilling and dimensions conforming to ANSI B16.1.

.4 Minimum shut off pressure of 1,034 kPa (150 PSI).

.5 Materials of Construction:

.1 Seat - SS 316.

.2 Stem - SS 316.

.3 Packing - Teflon.

.6 Actuators:

.1 Input and output signals:

.1 4-20 mA position command input.

.2 4-20 mA position feedback output.

.2 Sized for 1.25 maximum torque requirements of the shut-off pressure rating.

.3 Designed to operate with 24 volt AC.

.4 Power and controls terminals shall be segregated.

.5 The actuator motor shall be rated for 600 starts per hour.

.6 Starter shall be solid state type where applicable.

.7 Minimum stroke speed of 3.8 mm/s.

.8 Actuator shipped from factory shall include the motor, manual hand wheel and limit switches as one unit.

.9 Actuator shall allow for manual operation of the valve in case of control or power failures.

.7 A physical indicator shall show valve position.

.8 Standard of Acceptance: Siemens Flowrite FCV – No Exceptions.

2.9 Energy Meter (JQ)

.1 Every Energy meter includes an energy calculator a flow meter (FT) and two (2) temperature elements (TE).

.2 All Energy Meter components shall be in compliance to EN 1434.

.3 All Energy Meter components shall be factory calibrated and supplied with corresponding calibration certificates.

.4 Energy Calculator (JQ):

.1 Accuracy of (0.15+2/Δt)%.

.2 BACnet compatible.

.3 Modbus RTU and/or ModbusTCP compatible.

.4 4-20 mA output signals for the instantaneous flow and energy.

.5 A minimum battery life of 5 years.

.6 Built-in data logging for a minimum of 15 years.

.7 Local data retrieval capability.

.8 Minimum information for display and communication:

.1 Totalized energy (MW.hr).

.2 Totalized Flow (m^3).

.3 Instantaneous flow (L/s).

.4 Supply Temperature (°C).

.5 Return Temperature (°C).

.6 Differential Temperature (°C).

.9 Standard of Acceptance: Kamstrup MultiCal 602 – No Exceptions.

.5 Flow Meter (FE)

.1 The flow meter shall be ultra-sonic or tube type magnetic flow meters with ANSI Class 150 or 300 RF flange ends with drilling and dimensions conforming to ANSI B16.1

.2 Materials of Construction:

.1	Flanges	-	Carbon Steel
.2	Metering tube	-	SS 316
.3	Electrodes	-	Stainless steel
.4	Liner	-	Teflon

.3 Accuracy (minimum)

.1 ±0.5% of flow meter range (corresponding to velocities of 0.3 to 10 meters per second) for each flow meter.

.4 Electrical Power 120 volt AC +/-20% at 60 Hz.

.5 The flow meters shall have the following construction and features:
.1 4 - 20mA Active Output Current.
.2 Digital Display - 2 line (minimum) display.
.3 Remote configuration feature.

.6 Complete dimensional prints, electrical schematics and technical literature for the magnetic flow meter, transmitter and associated components shall be submitted for the Engineer's approval prior to placing order for supply.

.7 Stainless steel data plate to indicate instrument number.

.8 Standard of Acceptance:

.1 Endress-Hauser.
.2 ABB.
.3 Siemens.
.4 Kamstrup.
.5 Approved equal.

.9 All flow meters shall be the same model and supplied by a single supplier.

.6 Temperature Element (TE)

.1 Provide “paired” 4-wire Resistive Temperature Detector (RTD) probes as follows:

.1 316 stainless steel sheath spring loaded RTD probe compatible with Contractor supplied thermowells extending to 40% - 60% of the service pipe diameter.
.2 ¾” NPT 316 SS tapered thermowell with a 2” extension for the pipe insulation.
.3 NEMA 4 enclosure.

.2 Accuracy limits shall be as follows:

.1 Accuracy, repeatability and linearity to ± 0.15% of calibrated span.
.2 Transmitter calibrated for 4 wire PT 500 ohm platinum RTD input.
.3 4 - 20mA (loop powered, 24VDC) isolated output.

.3 Stainless steel data plate to indicate instrument number.

.4 Standard of Acceptance:
.1 ABB.
.2 Endress – Hauser.
.3 Kamstrup.
.4 Approved equal.

2.10 Pump Current Switches

.1 Provide 2 pump current switches capable of monitoring the operation of 2 x 5 HP pump located on the fields operating at 208 volts, 3 phase.

.2 The output shall be compatible the ETS Control Panel PLC discrete input module.

.3 Approved product

.1 NK Technologies AS3 series.

2.11 Communication

.1 The Contractor shall install a communication conduit from the building penetration to the ETS Control Panel.

.2 The fibre cable supply and installation will be done by the owner.

PART 3 EXECUTION

3.1 General

.1 Refer to Manufacturer's instructions for the installation of all controls components.

.2 All flow meters and control valves shall be field insulated using an insulation blanket.

.3 The Contractor shall provide all software and programming for the Controller (PLC) and the Operator Interface Panel. Software shall be turned over to the Owner following successful commissioning of the control system. Refer to Part 4 for Functional Description.

3.2 Transmitters

.1 Transmitters shall be stored by the Contractor on site in a clean, heated and secure environment.

.2 Install in accordance with the manufacturer's detailed instructions.

.3 Mount as shown on P&ID's.

.4 Piping connections will be completed by the Mechanical Trade.

.5 Confirm, and if necessary adjust, the factory calibrated zero suppression/elevation and range for each pressure transmitter.

3.3 Flow Meters

.1 Install in accordance with the manufacturer's detailed instructions.

.2 Follow manufacturer's requirements for minimum straight length to meet the rate accuracies.

3.4 Pump Current Switches

.1 The 2 pump current switches and associated field wiring shall be installed on the existing pumps located in the field.

PART 4 FUNCTIONAL DESCRIPTION

4.1 System Overview

.1 The controls architecture for this system is to control the transfer of heat from the energy source (primary side) to the individual building loads (secondary side) via the energy transfer stations (ETS).

.2 The main system components include:

.1 Heat exchangers.

.2 Control valves.

.3 Energy meters.

.4 Temperature and pressure sensors.

.3 Each individual ETS will have its own standalone control system that will enable seamless operation in case communication is lost with the central control system.

4.2 Control Valve

.1 Automatic mode.

.1 Control valve shall modulate flow to maintain a set point for the secondary fluid discharge temperature.

.2 Control valve to allow a pre-set maximum flow.

.3 Control valve shall close in the absence of flow on the secondary side; absence of flow on the secondary side shall be determined using supply/return temperature transmitters or pump status from the secondary side BMS.

.2 Semi-automatic mode.

.1 Control valve shall modulate the flow based on a flow set point entered by the user.

.3 Manual mode.

.1 User to set valve position.

4.3 Instrumentation Indicators

.1 Refer to P&ID's for instrumentation indicator requirements.

4.4 Alarm Schedule

.1 Secondary fluid discharge temperature low limit.

.2 Domestic hot water fluid discharge temperature high limit.

.3 High pressure limit.

.4 High flow limit.

PART 5 SCOPE OF SUPPLY SCHEDULE

5.1 Instrument List

.1 Refer to Table 1 in Section 01110.

END OF SECTION