Public Works and Government Services Canada

Requisition Number: _____

MERX I.D. Number: _____

SPECIFICATIONS for:

CANADIAN FOOD INSPECTION AGENCY
BURNABY LAB
BOILER REPLACEMENT

Project No: 39903-150594

ISSUED FOR TENDER

APPROVED BY:

_____ _____
Regional Manager, AES Date

_____ _____
Construction Safety Coordinator Date

TENDER:

_____ _____
Project Manager Date

CONSULTANTS – SEAL & SIGNATURE

Mechanical
Stantec Consulting Ltd.

(Professional's Seal and Signature)

DEC 2 1 2015

Date

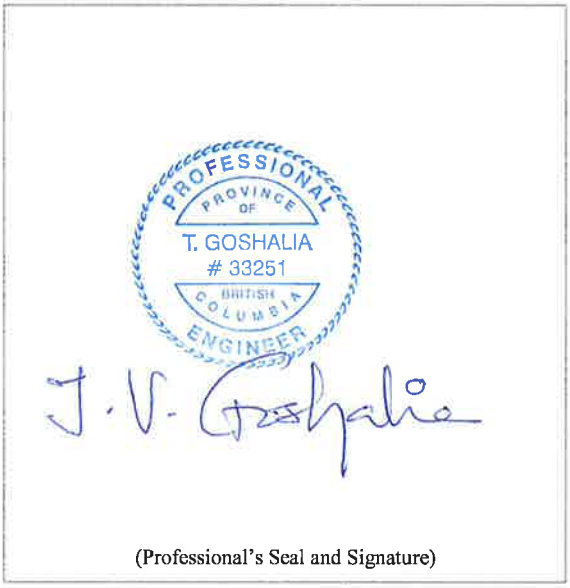
Electrical
Stantec Consulting Ltd.

(Professional's Seal and Signature)

DECEMBER 21, 2015

Date

Structural
Stantec Consulting Ltd.



(Professional's Seal and Signature)

2015 DEC 21
Date

END OF SECTION

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1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 00 – Special Procedures.

.3 Section 23 05 00 – Common Work Results for HVAC.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises replacement of boilers and primary loop pumps, with some piping upgrades at CFIA Burnaby Laboratory (3155 Willingdon Green, Burnaby, BC), further identified as CFIA.

The project includes but is not limited to:

.1 Replacement of existing boilers B-1, B-2 and B-3.

.2 Provision of new boiler and primary loop heating water pumps.

.3 Addition of chemical treatment package.

.4 Provision of new control system to the new mechanical equipment.

.5 Electrical work upgrade to accommodate mechanical system upgrade.

.6 Structural upgrade to support upgrade to the mechanical equipment.

.7 Phased construction, to accommodate limited interruption to the services of the building.

.8 Supply and installation of a complete, fully functional, tested, and commissioned mechanical system, with ancillaries.

.9 Restoration of any finishes affected by the work.

.2 All materials and equipment supplied and installed shall be new except the relocated equipment specified in the drawings.

.3 Commissioning works includes mechanical, electrical, and structural components and systems.

.4 Return all reusable removed equipment to CFIA as directed by the Departmental Representative. Coordinate and confirm with CFIA for all the reusable equipment. Move and store in a location on the premises, designated and coordinated with CFIA.

1.4 CONTRACT METHOD

.1 Construct Work under single, stipulated price contract.

1.5 WORK BY OTHERS

.1 N/A.

1.6 WORK SEQUENCE

.1 Construct Work in stages to accommodate Owner's continued use of premises during construction.

.2 Coordinate Progress Schedule and coordinate with Owner’s Occupancy during construction.

.3 Maintain fire access/control.

.4 Required construction phases: Phased construction is required to accommodate limited interruption permitted to the services of the building (heating water and electrical). Phased construction is also depicted on the drawings, and includes the following general phases:

.1 Phase 1: Remove existing boilers B-301 and B-302 in the boiler room, complete with the connection piping and associated boiler pumps and valves (existing boiler B-303 maintains service to the building). Cap off any services to the existing system, such as water supply, hot water takeoffs, controls, power, etc. Remove all redundant piping, hangers, braces and brackets.
Install new structural pad as required.
Note: Maximum shutdown for the heating water system shall be minimized; coordinate with the Departmental Representative and CFIA. Organize the work to minimize required drainage, minimize the duration of the shutdown, and minimize the number of shutdowns.

.2 Phase 2A: Provide new boilers B-301 and B-302. The work needs to be completed by the end of phase 2B.

.3 Phase 2B: During a shutdown, remove existing piping mains and existing primary pumps. Install new piping mains, ancillaries and primary pumps in new location.
Test and commission new pumps and new boilers before connecting them to serve the heating loop.
Parts of phase 2B work can occur concurrent with work in Phase 1.

.4 Phase 3: With boilers B-301 and B-302 serving the building, remove and replace boiler B-303.
Remove redundant piping and ancillaries in boiler room. Final project cleanup.

.5 Contractor shall coordinate with the Departmental Representative and CFIA, and allow adequate construction stages in the tender prices to meet the site condition, minimal interruption to the building services permitted, and the phased nature of the project, understanding that each phase of the project needs to be fully functional and operating before proceeding with the next phase.

.6 Staged testing, balancing, and commissioning shall be provided such that the equipment and the systems are fully functional, tested, balanced, controlled and commissioned after each phase of work, before proceeding with the next phase.

.7 Organize the work to minimize required heating system stoppages, minimize the duration of the shutdown, and minimize the number of shutdowns. Contractor shall coordinate every shutdown with the Departmental Representative and CFIA. Note that some shutdowns may need to be deferred, to accommodate normal operation of the Lab.

1.7 SITE MEETINGS

.1 Construction meetings with Departmental Representative to be held on site bi-weekly.

.2 All contractors shall also attend bi-weekly site meetings.

.3 Contractors shall attend commissioning meetings.

1.8 CONTRACTOR USE OF PREMISES

.1 Contractor shall limit use of premises for work, for storage, and for access, to allow Owner's normal use of the building.

.2 Coordinate use of premises, such as work areas, storage, delivery of materials and equipment, parking, washroom facilities provision and use, elevator, power and water use shall be coordinated with and under direction of Departmental Representative. See Section 01 35 00 for contractor entry/exit of primary staging area, entry log, and contractor parking locations.

.3 Contractor shall supply all necessary signage, hoarding and fencing.

.4 Contractor is responsible for all dust control measures. Contractor shall maintain the work areas under negative pressure to minimize potential for dust spread in the building.

.5 Contractor shall coordinate all work during normal hours of operation, 8:00 am - 5:00 pm. Coordinate all deliveries to minimize the disruption to the normal operation of the facility - coordinate with the Departmental Representative.

.6 All work to be performed after hours shall be coordinated with the Departmental Representative.

.7 Any work performed by the contractor outside of normal working hours requires notification and adherence to the on-site security measures.

.8 A temporary storage area for removed equipment is to be located in a designated storage area (e.g. adjacent to the C-Can storage); coordinate with, and work under direction of Departmental Representative. Coordinate waste disposal with Contractors working on other projects on site; coordinate through and under direction of Departmental Representative.

.9 Contractor shall supply all hoarding and fencing. See Section 01 35 00.

.10 Contractor shall abide by all on-site security provisions and regulations.

.11 Contractor entrance shall be at the loading dock for loading and unloading equipment.

1.9 OWNER OCCUPANCY

.1 CFIA will occupy premises, and carry out normal operation of the facility, during entire construction period.

.2 Cooperate with Departmental Representative in scheduling operations to minimize interruption or conflict and to facilitate Owner usage of the facility.

1.10 CONTRACTOR FURNISHED ITEMS

.1 Contractor Responsibilities:

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

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

.3 Receive and unload products at site.

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

.5 Protect products from damage and from exposure to elements.

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

.7 Provide installation inspections required by local authorities.

.8 Repair or replace and make good items damaged by contractor on site during construction.

.9 The word “make good” used in the contract documents means “to restore new or existing work after being damaged, cut, patched or rejected by the Departmental Representative” and also means “using materials identical to the original materials with visible surfaces matching the appearance of the original surfaces in all details and with no apparent junctions between new and original surfaces. Where original materials are no longer available, the Contractor may submit a proposal of materials for review by the Departmental Representative.”

1.11 MOCK-UP

.1 N/A.

1.12 SAFETY WORKING PROCEDURE

.1 Working process shall follow the “Safe Working Procedures for Contractors.”

.2 Observe building security measures.

1.13 ASBESTOS REMOVAL

.1 If the Contractor, during renovations / demolition, should discover asbestos (or material suspected to be asbestos) on piping, ductwork, etc., he shall immediately cease all work in that area and advise the General Contractor. The General Contractor shall take immediate appropriate action to verify presence of friable asbestos and be responsible for the removal of all friable asbestos.

.2 The Contractor will not be entitled to a claim for any delays resulting from the investigation of or removal of asbestos.

.3 Asbestos shall be removed in accordance with the regulations for handling hazardous material.

.4 Asbestos removal will be considered extra cost.

1.14 CONSTRUCTION PERIOD

.1 Allowable time for construction: expected completion of the project is December 20, 2016.

END OF SECTION

Part 1 General

1.1 CODES

.1 Perform work in accordance with National Building Code for Canada 2010, Workers' Compensation Board of BC, BC Building Code 2012, and any other code of provincial or local regulation, standard or application provided that, in any case of conflict or discrepancy, the more stringent requirements shall apply.

.2 The design of equipment pads and other non-structural elements shall be in accordance with CAN/CSA S832 Seismic Risk Reduction of Operational and Functional Components of Buildings.

.3 Meet or exceed requirements of specified standards, codes, and referenced documents.

1.2 DESCRIPTION OF WORK

.1 Work under this Contract comprises, but is not limited to, the provision of all labour, materials, services, and equipment necessary for the work for replacement of boilers and primary loop pumps, with some piping upgrades at CFIA Burnaby Laboratory (3155 Willingdon Green, Burnaby, BC), as fully described in the Tender Documents.

1.3 CONTRACT DOCUMENTS

.1 The Contract documents, drawings, and specifications are intended to complement each other.

.2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.

.3 Coordinate with pre-purchased equipment suppliers in carrying out their respective works and carry out instructions from Departmental Representative.

.4 Coordinate work with that of pre-purchased equipment suppliers. If any part of work under this Contract depends on its proper execution or result upon work of said suppliers, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of this Work.

.5 Read structural drawings in conjunction with all other pertinent contract documents. Coordinate structural work with mechanical and electrical drawings for detailed dimensions, locations of door and window openings, slopes, curbs, pads, drainage and waterproofing, duct openings, recesses, inserts and other items.

.6 Notify the Departmental Representative 72 hours in advance for observation and/or inspection of reinforcing steel and pour conditions before any concrete pour.

.7 Drawings show completed structures only. Provide temporary bracing and shoring for construction loading conditions and stability of the structure during construction. Operating loads including operating equipment and personnel may not exceed following:

.1 At roof max distributed live load = 1.0 kPa.

.2 At penthouse, max distributed live load = 4.8 kPa.

.3 Any equipment such as scissor lift / geni-lift / etc., employed to move construction material over existing roof shall limit its load effects to above stated limit.

.8 Construction methods requiring temporary shoring, or bracing, shall be submitted to the structural engineer for review. The contractor shall retain a Professional Engineer registered in the province of British Columbia to perform and take responsibility for any shoring or other designs to complete the construction.

1.4 TIME OF COMPLETION

.1 Commence work immediately upon official notification of acceptance of offer and complete the project, including testing, adjusting, and commissioning, per Section 01 11 00 – 1.14 – Construction Period.

1.5 HOURS OF WORK

.1 CFIA will occupy premises, and carry out normal operation of the facility, during entire construction period. Cooperate with Departmental Representative in scheduling operations to minimize interruption or conflict and to facilitate Owner usage of the facility.

.2 All work which generates excessive noise and vibration, including cutting and coring, work on or chipping of floor slab shall be executed outside of the normal operating hours, except Saturdays and Sundays.

.3 All other work, except for that noted in Clause 1.5.1, shall be executed during the normal operating hours:

- Monday through Friday – 0700 to 1700 hours.

.4 All work conducted during or outside of normal operating hours will be subject to restrictions outlined in Sections 01 14 00 and 01 51 00, including security arrangements.

1.6 WORK SCHEDULE

.1 Carry out work as follows:

.1 Within 10 working days after Contract award, provide a “phasing bar chart” and a schedule showing anticipated progress stages and final completion of the work within the time period required by the Contract documents. Indicate the following:

.1 Submission of shop drawings, product data, MSDS sheets, and samples;

.2 Commencement and completion of work of each section of the specifications or trades for each phase as outlined;

.3 Final completion date within the time period required by the Contract documents.

.2 Do not change approved Schedule without notifying Departmental Representative.

.3 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and the schedule updated by Contractor in conjunction with and to approval of Departmental Representative.

.4 All activities will be coordinated with and to approval of Departmental Representative. Provide minimum 2 week notice for any shutdowns; arrange work to minimize shutdown duration. Coordinate with Departmental Representative.

1.7 COST BREAKDOWN

.1 Before submitting the first progress claim, submit a breakdown of the Contract price in detail as directed by the Departmental Representative and aggregating Contract price. After approval, the cost breakdown will form the basis of progress payments.

.2 General Contractor, Mechanical and Electrical Sub-Contractor shall attend meetings with Departmental Representative, as required, to finalize the breakdown.

1.8 CODE, BYLAWS, STANDARDS

.1 Perform work in accordance with the National Building Code of Canada (NBC) 2010, and other indicated codes, construction standards, and/or any other code or bylaw of local application.

.2 Comply with applicable local bylaws, rules, and regulations enforced at the location concerned.

.3 Meet or exceed requirements of Contract documents, specified standards, codes, and referenced documents.

.4 In any case of conflict or discrepancy, the most stringent requirements shall apply.

.5 Apply for and meet requirements of all trade permits and certification.

1.9 DOCUMENTS REQUIRED

.1 Maintain one (1) copy each of the following at the job site:

.1 Contract drawings;
.2 Contract specifications;
.3 Addenda to Contract documents;
.4 Copy of work schedule;
.5 Reviewed shop drawings;
.6 Change orders;
.7 Other modifications to Contract;
.8 Field test reports;
.9 Reviewed samples;
.10 Toolbox training / safety meeting minutes;
.11 Manufacturer’s installation and application instructions;
.12 One set of record drawings and specifications for “as-built” purposes;
.13 National Building Code of Canada 2010;
.14 Current construction standards of workmanship listed in technical sections;
.15 Building Safety Plan.

1.10 REGULATORY REQUIREMENTS

.1 Building Permit

.1 Contractor shall apply for and pay for the building permit for this project.

.2 Apply for and meet requirements of all trade permits and certification.

.3 Provide inspection authorities with plans and information required for issue of acceptance certificates.

.4 Furnish inspection certificates in evidence that the work installed conforms to the requirements of the specification.

1.11 CONTRACTOR'S USE OF SITE

.1 Use of site:

.1 Exclusive and complete for execution of work.

.2 Assume responsibility for assigned premises for performance of this work.

.3 Be responsible for coordination of all work activities on site, including the work of other contractors engaged by the Departmental Representative.

.4 Coordinate with Departmental Representative for use of storage or work areas needed for operations under this Contract.

.2 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with approved schedules.

.3 Do not unreasonably encumber site with material or equipment.

1.12 EXAMINATION

.1 Examine site and be familiar and conversant with existing conditions likely to affect work.

1.13 EXISTING SERVICES

.1 Where Work involves breaking into or connecting to existing services, carry out work as directed in Section 01 14 00 – Work Restrictions.

.2 Record locations of maintained, re-routed, and capped off / removed service lines (do not abandon services, and leave in place – every abandoned service shall be removed).

.3 Construct hoarding and barriers in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.

1.14 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures, and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures, and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access, and maintenance.

.3 Inform Departmental Representative of impending installation and obtain his approval for actual location.

.4 Submit field drawings or shop drawings to indicate the relative position of various services and equipment when required by the Departmental Representative and/or as specified.

1.15 CUTTING AND PATCHING

.1 Cut existing surfaces as required to accommodate new work.

.2 Remove items so shown or specified.

.3 Do not cut, bore, or sleeve load-bearing members.

.4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.

.5 Fit work airtight to pipes, sleeves, ducts and conduits.

.6 Conceal pipes, ducts and wiring in raised floors, wall, and ceiling construction of finished areas except where indicated otherwise.

.7 Patch and make good surfaces cut, damaged, or disturbed, to Departmental Representative's approval. Match existing material, colour, finish, and texture.

.8 “Making good” is defined as matching construction and finishing materials and the adjacent surfaces such that there is no visible difference between existing and new surfaces when viewed from 1.5 metres in ambient light, and includes painting the whole surface to the next change in plane.

1.16 SETTING OUT OF WORK

.1 Assume full responsibility for and execute complete layout of work to locations, lines, and elevations indicated.

.2 Provide devices needed to lay out and construct work.

.3 Supply such devices as templates required to facilitate Departmental Representative's inspection of work.

1.17 ACCEPTANCE OF SUBTRADES

.1 Each trade shall examine surfaces prepared by others and job conditions which may affect his work, and shall report defects to the Departmental Representative. Commencement of work shall imply acceptance of prepared work or substrate surfaces.

1.18 QUALITY OF WORK

.1 Ensure that quality workmanship is performed through use of skilled tradesmen, under supervision of qualified journeyman.

.2 The workmanship, erection methods and procedures to meet minimum standards set out in the National Building Code of Canada 2010 and Construction Standards as specified herein.

.3 In cases of dispute, decisions as to standard or quality of work rest solely with the Departmental Representative, whose decision is final.

.4 Quality of work shall in to case be of lesser standard compared to the existing.

1.19 WORKS COORDINATION

.1 Coordinate work of sub-trades:

.1 Designate one person to be responsible for review of contract documents and shop drawings and managing coordination of Work.

.2 Convene meetings between subcontractors whose work interfaces and ensure awareness of areas and extent of interface required.

.1 Provide each subcontractor with complete plans and specifications for Contract, to assist them in planning and carrying out their respective work.

.2 Develop coordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.

.1 Pay particularly close attention to overhead work above ceilings and within or near to building structural elements.

.2 Identify on coordination drawings, building elements, services lines, rough-in points and indicate location services entrance to site.

.3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign off on drawings.

.4 Publish minutes of each meeting.

.5 Plan and coordinate work in such a way to minimize quantity of service line offsets.

.6 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.

.3 Submit shop drawings and order of prefabricated equipment or rebuilt components only after coordination meeting for such items has taken place.

.4 Work cooperation:

.1 Ensure cooperation between trades in order to facilitate general progress of Work and avoid situations of spatial interference.

.2 Ensure that each trade provides all other trades reasonable opportunity for completion of Work and in such a way as to prevent unnecessary delays, cutting, patching, and removal or replacement of completed work.

.3 Ensure disputes between subcontractors are resolved.

.5 Departmental Representative is not responsible for, nor accountable for, extra costs incurred as a result of Contractor's failure to coordinate Work.

.6 Maintain efficient and continuous supervision.

1.20 APPROVAL OF SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

.1 In accordance with Section 01 33 00, submit the requested shop drawings, product data, MSDS sheets, and samples indicated in each of the technical sections.

.2 Allow sufficient time for the following:

.1 Review of product data,

.2 Approval of shop drawings,

.3 Review of re-submission,

.4 Ordering of approved material and/or products. Refer to individual technical sections of specifications.

1.21 PROJECT MEETINGS

.1 Contractor shall arrange project meetings and assume responsibility for setting times and distributing minutes.

.2 The contractor shall provide the meeting facilities, record the meeting minutes and issue a meeting agenda three (3) days prior to the meeting to Departmental Representative for review.

1.22 TESTING AND INSPECTION

.1 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified in Sections 01 45 00 – Quality Control.

.2 The Contractor will appoint and pay for the services of testing agency or testing laboratory as specified, and where required for the following:

.1 Inspection and testing required by laws, ordinances, rules, regulations, or orders of public authorities.

.2 Inspection and testing performed exclusively for Contractor's convenience.

.3 Testing, adjustment, and balancing of mechanical and electrical equipment and systems.

.1 Mill tests and certificates of compliance.

.2 Tests specified in the contract documents to be carried out by Contractor which may be under the Departmental Representative's supervision.

.3 Within 15 working days after Contract award, provide a list of proposed testing services or testing laboratories for Departmental Representative’s approval.

.4 The Departmental Representative may require, and pay for, additional inspection and testing services not included in paragraph 1.22.2.

.5 Where tests or inspections by designated testing laboratory reveal work is not in accordance with the Contract requirements, Contractor shall pay costs for additional tests or inspections as the Departmental Representative may require to verify acceptability of corrected work.

.6 Contractor shall furnish labour and facilities to:

.1 Notify Departmental Representative in advance of planned testing.

.7 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.8 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.

.9 Provide Departmental Representative with two (2) copies of testing laboratory reports as soon as they are available.

1.23 AS-BUILT DOCUMENTS

.1 Keep one set of current white prints of all contract drawings and all addenda, revisions, clarifications, change orders, and reviewed shop drawings in the site office; and have them available at all times for inspection by the Consultant.

.2 As the Work progresses, maintain accurate records to show all deviations from the Contract documents. Note on as-built specifications, drawings, and shop drawings as changes occur.

.3 At completion of the Work, transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings, and change order, to a set of Issued for Construction drawings. Submit the 'red-marked' as-built set to the Owner, in hard copy and in PDF.

.4 Arrange for and be responsible for the preparation of as-built drawings in AutoCAD computerized drafting system. Be responsible for the cost of preparation of as-built drawings. Submit electronic copy of the as-built drawings on CD/DVD media in CAD and PDF format, as well as 2 sets of hard copies. Submit as-built drawings before requesting Substantial Completion.

.5 Refer to Section 01 78 00 – Closeout Submittals.

1.24 CLEANING

.1 Refer to Section 01 74 11 - Cleaning.

1.25 DUST CONTROL

.1 Provide temporary dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of work, and public.

.2 Protect furnishings and equipment within work area with 0.102 mm thick polyethylene film during construction. Remove film during non-construction hours and leave premises in clean, unencumbered, and safe manner for normal daytime function.

.3 Maintain and relocate protection until such work is complete.

1.26 ENVIRONMENTAL PROTECTION

.1 Prevent extraneous materials from contaminating air beyond construction area by providing temporary enclosures during work.

.2 Do not dispose of waste or volatile materials into water courses, storm or sanitary sewers.

.3 Ensure proper disposal procedures in accordance with all applicable territorial regulations.

1.27 MAINTENANCE MATERIALS, SPECIAL TOOLS AND SPARE PARTS

.1 Specific requirements for maintenance materials, tools and spare parts are specified in individual technical sections of specifications.

1.28 ADDITIONAL DRAWINGS

.1 Contractor can obtain and Download Tender Documents from Buy&Sell website, and print the documents as needed.

.2 The Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with drawings referred to in the Contract Documents. Such documents will also be available on Buy&Sell website.

1.29 BUILDING SMOKING ENVIRONMENT

.1 Smoking within the building and within 7.5m of all air intakes is not permitted.

.2 A 'No Smoking' sign to be put up by Contactor.

.3 Observe designated smoking areas.

1.30 SYSTEM OF MEASUREMENT

.1 The metric system of measurement (SI) will be employed on this Contract.

1.31 FAMILIARIZATION WITH SITE

.1 Before submitting tender, visit site as indicated in tender documents and become familiar with all conditions likely to affect the cost of the work.

1.32 SECURITY REQUIREMENTS

.1 Refer to Section 01 14 00 – Work Restrictions.

1.33 SUBMISSION OF TENDER

.1 Submission of a tender is deemed to be confirmation of the fact that the Tenderer has analyzed the Contract documents and inspected the site, and is fully conversant with all conditions.

1.34 SUBSTANTIAL COMPLETION

.1 Substantial Completion of work will only apply after all phases are complete, connection of all equipment and piping, the new systems are commissioned and functional, and confirmed that all systems are operational for commissioning by the Departmental Representative.

.2 All submissions shall be complete prior to requesting Substantial Performance.

1.35 SPECIAL NOTE TO THE OWNER, AND TO THE PLAN-CHECK OFFICIAL AT THE CITY OF BURNABY, BC

.1 The proposed alterations for mechanical systems consist of following:

.1 Replacing three existing boilers located in the mechanical penthouse on roof with three new boilers. Each of the existing boiler system is approximately 2000 lbs in operating weight. The new complementing boilers is approximately 2500 lbs in operating and of a smaller overall size.

.2 Replacing mechanical piping, pumps, and other similar associated equipment-accessories to support the new boilers. New piping and accessories is of comparable or smaller in size and lighter in weight.

.3 Addition of a new concrete housekeeping pad, approximately 1300 x 2400 x 120 thick, and associated anchors into existing concrete roof waffle-floor. Providing new post-installed anchors into associated housekeeping concrete pads to secure the new boilers and new pump accessories.

.4 Providing new attachment hangers and seismic bracings connected to overhead roof structure.

.2 Structural review of the existing building structure is conducted to evaluate the implications of the new mechanical alterations proposed herein. The scope of this review is limited to the new mechanical upgrades. It shall not be interpreted as an assessment of the entire existing building structure.

.3 The limited review consisted of following:

.1 Reviewing existing structure drawings s.1 to s.20, dated 1984-07-13 and design-sealed by r. J. Riley.

.2 In-field observation of existing building.

.4 Based on our limited review and observations, in our opinion:

.1 The existing building structure appears in good condition assuming it to be represented by the 1984 date d structural drawings.

.2 The new alterations and additions are minor in nature with negligible change to the overall seismic mass or stiffness of the building.

.3 The new equipment and associated accessories do not have any adversely vibrating parts or vibration inducing behaviour, nor do they require snubbers or vibration isolators.

.5 Additions and alterations described above and the associated load effects attributed on to the original existing building structure is considered minor in nature and well within the standard-practice general design allowance typically considered for such buildings and hence assumed to have been provided for in the original 1984 existing building design.

.6 Based on above, the undersigned structural engineer of record and Stantec Consulting Ltd. assume limited responsibility of the localized structural design for alterations and additional proposed herein. Our design intent has been to make minimal changes affecting the overall building structure. Thus we do not propose to intentionally or inadvertently change the original structural design or behaviour or design-life of the original existing building structure nor propose to intentionally or inadvertently assume responsibility of the entire original existing building structure.

1.36 SPECIAL NOTE TO CONTRACTOR:

.1 Construction sequence during disassembly of existing equipment and installation of new equipment will not overstress, or cause sudden impact or damage to existing structure.

.2 Construction loads shall be distributed at all times so as not to exceed the distributed design live loads specified.

.3 Existing lateral load resisting structural elements such as concrete walls, steel bracing, etc. shall not be adversely disturbed or damaged.

.4 Any damage to existing structure, equipment or components shall be repaired to the Departmental Representative's satisfaction by the Contractor at Contractor's own expense (and at no cost to the Departmental Representative).

.5 New equipment / component sizes will be such that they can be brought into the mechanical penthouse through existing doors and when assembled, the new equipment system will fit within existing structural clearances without relocation of structural member.

.6 Where new housekeeping pad is proposed over the existing penthouse waffle slab floor, the existing concrete surfaces will be lightly chipped to a 6 mm amplitude rough surface and then blast cleaned. Apply bonding agent prior to concrete pour. The new concrete house-keeping pads shall match the height of existing adjacent pads.

.7 Housekeeping pad shall be poured level. Boiler equipment shall be installed plumb vertical.

.8 New piping may be supported off the existing steel roof structure. All hangers and diagonal bracing shall be connected to the top flange of roof beams or roof open web steel joists. If any support bracings, hangers, or attachments are made to bottom flange of existing beams or OWSJ, then such bottom flanges shall be laterally braced.

.9 New openings in existing steel roof deck or walls are not expected. If required, these will be located between existing roof beams / OWSJ and will be provided with new edge framing as necessary. Provide signed and sealed design drawings and calculations for the Departmental Representative review prior to such selective demolitions or construction.

.10 The comprehensive design of all supports and anchorage related to the proposed mechanical and electrical alterations and additions shall be signed and sealed by a specialty Professional Engineer licensed in the province of British Columbia. Submit a signed sealed copy of such design calculations and drawings for the Departmental Representative's review upon request. Submit such specialty scope related schedules and letters of assurance/compliance upon request.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES:

.1 Connecting to existing services.

.2 Special scheduling requirements.

1.2 RELATED SECTIONS

.1 Section 01 35 00 – Special Procedures.

.2 Section 01 56 00 - Temporary Barriers and Enclosures.

1.3 EXISTING SERVICES

.1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 72 hours of notice for necessary interruption of mechanical or electrical service throughout course of work (note that some of the programs in existing labs have a run time of 3-4 days!). Keep duration of interruptions to a minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

.3 Provide for unobstructed pedestrian and vehicular traffic.

.4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

.5 Coordinate with Departmental Representative if multiple shutdowns are required; timing shall be coordinated with CFIA staff to minimize disruption to ongoing work in process areas and labs, which is supported by the heating water loop. Arrange work to minimize the required drain down.

.6 Organize the work to minimize required heating system stoppages, minimize the duration of the shutdown, and minimize the number of shutdowns. Contractor shall coordinate every shutdown with the Departmental Representative and CFIA. Note that some shutdowns may need to be deferred, to accommodate normal operation of the Lab.

1.4 SPECIAL REQUIREMENTS

.1 Observe and comply with security requirements.

.2 Paint public or staff occupied areas Monday to Friday from 1800 to 0700 hours only and on Saturdays, Sundays, and statutory holidays. Coordinate with Departmental Representative.

.3 Carry out noise generating Work (such as drilling and coring building structures or similar noise level generating work) Monday to Friday from 1800 to 0700 hours and on Saturdays, Sundays, and statutory holidays. Coordinate with Departmental Representative.

.4 Contractor shall only work on the areas for which the construction works are scheduled, and the testing and commissioning are required to perform before occupancy. Refer to Sections 01 11 00 - Summary of Work for the stages and phases of construction.

.5 Contractor and sub-contractors shall undergo security screening.

.6 Maintain an acceptable indoor environmental quality during construction. Apply measures such as:

.1 Prevention of the construction dust from spreading into the laboratory or other spaces;

.2 Pressure differential is to be maintained between the construction and the occupied zones;

.3 Fire protection;

.4 Prevention of fumes from welding or cutting.

1.5 FACILITY ORIENTATION FOR CONSTRUCTION AND SERVICE CONTRACTORS

.1 Refer to the enclosed CFIA Facility Orientation for Construction and Service Contractors.

END OF SECTION

Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

BURNABY LABORATORY

3155 Willingdon Green
Burnaby, British Columbia

FACILITY ORIENTATION FOR CONSTRUCTION AND SERVICE CONTRACTORS

Building Main Contact Numbers:

Name	Organisation	Position/Role	Office	Mobile
Ian Murdoch	CFIA-ACIA	Facilities Manager	604-292-6060	778-877-0294
Neil Randlesome	CFIA-ACIA	Maintenance Specialist	604-290-6061	604-834-6861
Elmer Castro	CFIA-ACIA	Building Maintainer	604-292-6062	604-834-6623
Security/Reception		Commissionaire	604-292-6001	
Dave Graham	CFIA-ACIA	Director	604-292-6066	
Jenny Lomas	CFIA-ACIA	Safety Coordinator	604-292-6065	

Facility Protocols

CFIA Facilities Management and the client occupants of this building have agreed that the following procedures will apply to all persons carrying out work at this site.

THIS LIST IS NOT LIMITED TO THE ITEMS MENTIONED, AND MAY BE SUBJECT TO CHANGE WITHOUT NOTICE.

Visitor / Contractor Safety

To ensure the health and safety for all staff and visitors, please read this binder before entering this laboratory facility.

- All visitors must sign in and wear a visitor pass.
- All contractors must sign the Visitor's Log and the Laboratory Contractor Safety Checklist prior to commencing any work in laboratory areas or any exterior work that will compromise the integrity of the building envelope.
- Smoking is NOT PERMITTED in any areas.

No Unauthorised Disruption in Services

48 hours advance written authorisation is required for all planned requirements for building access, key authorisation, fire alarm by-passes, life safety, electrical, heating, ventilation and air conditioning systems.

Switching of electrical breakers, cutting, drilling, welding / soldering, use of power tools, noise disturbances, any interior or exterior work that will compromise the integrity of a lab's envelope, and any other unauthorised disruption of services are strictly forbidden. This facility is protected by sensitive heat & smoke detection and computer control systems. Contractor assumes all responsibility for unauthorised disruption to client operations.

NO WORK OF ANY KIND, INTERIOR OR EXTERIOR, IS PERMITTED TO BE STARTED WITHOUT FIRST CONTACTING THE MAINTENANCE SPECIALIST OR THE BUILDING OPERATOR. CONTACT NUMBERS ARE ON THE FIRST PAGE OF THIS DOCUMENT.

General

CLEANING OF WORK SITES: Each contractor must clean the work area on an ongoing basis, and upon completion of the work or project. The building cleaners are not responsible for post construction clean-ups.

ELECTRICAL DISRUPTION / LOGBOOK: Arrangements for written authorisation must be made a minimum of 72 hours in advance. On completion of any new or substantial electrical repair work, the electrical inspection logbook located at the maintenance operations office must be filled out indicating type of work completed.

EMERGENCY: In the event of an emergency (fire, personnel accident, etc) call 911. If fire is detected and you are not able to suppress it, pull nearest pull station located at each exit and evacuate. For floods and emergency shutoffs call the Maintenance operations staff.

EXPLOSIVE TOOLS: Use of powder-activated tools is strictly prohibited.

FIRE ALARM BYPASSES: Arrangements for written authorisation must be made with CFIA maintenance operations a minimum of 48 hours in advance.

FIRE EXTINGUISHERS: Fire extinguishers are located throughout the building.

FIRE PLAN & EVACUATION: A copy of the evacuation plan indicating emergency exit locations is posted in the building. The contractor is responsible to familiarise themselves and their crew with the egress routes.

FREIGHT ELEVATOR: The freight elevator is available for use through arrangement with the Facility Manager / Project Manager. Extensive use of the freight elevator must be arranged 24 hours in advance. Maximum height is 7'6" and depth is 10'. Government staff and suppliers are given priority for the use. Users are expected to follow proper operating/safety procedures and capacity limits posted.

HVAC: Arrangements for written authorisation must be made a minimum of 48 hours in advance, for any disruption to the Heating, Ventilation or Air Conditioning systems.

HEALTH & SAFETY: There will be zero tolerance with respect to Health and Safety issues. Contractor(s) must adhere to all applicable federal and provincial Occupational Health and Safety regulations, use best safety practices at all times, and follow the rules governing this site. The principal contractor will be monitored and reported on their compliance.

HOLIDAY SCHEDULE: This facility recognises all federal and provincial holidays, in addition to Remembrance Day on November 11th.

HOURS OF OPERATION: Business hours are 08:00 to 16:00. If you require adjustments to the set schedules in order to perform your work; please make your requests to the Facilities Manager / Project Manager.

KEYS / ACCESS CARDS: Arrangements for written authorisation must be made with Facilities Manager / Project Manager a minimum of 48 hours in advance. Keys will not be released to contractors without prior written consent from CFIA Maintenance Operations.

KNOWN HAZARDS: This facility is heated by natural gas. Existing material safety data sheets for substances in use on site are available, designated substances reports are also available on site.

LOADING DOCK: The loading dock is for the loading and unloading of material only. Regular hours of operation are 08:00 – 16:00. There are no after-hours deliveries unless arranged in advance. Government staff and suppliers will be given priority at the loading dock. Safe work practices are to be followed in the loading and unloading of material.

NO SMOKING POLICY: Federal regulations do not permit smoking within the facility.

NO FOOD POLICY: Eating and drinking is not permitted in laboratory areas. The use of drugs or alcohol on CFIA facilities is strictly forbidden.

PARKING: Parking is restricted to assigned spaces for the time posted only; additional parking must be arranged through the Facilities Manager / Project Manager and approved.

SECURITY / ESCORTS: If the contractor holds a valid security clearance, escort requirements may not apply. Arrangements for written authorisation must be made a minimum of 48 hours in advance. All contractors must satisfy security requirements, visibly wear building pass at all times, and be readily identifiable by company name.

Security escorts may be required when working in certain areas. Regular hours of operation are between 08:00 and 16:00 hrs. The facility requires the names of persons requiring entry, locations requiring access, start and anticipated length of stay, and completion date of the work or project. The Facility / Project Manager are the main point of contact for making all arrangements. Failure to cancel, overbook, or underutilise security escort personnel could result in the contractor being back charged a minimum of 4 hours labour if 24 hours cancellation notice is not provided.

SUB-CONTRACTING: If the contract and work involves subcontracting any part of the Scope of Work, a representative from the contractors firm must accompany any sub trades and be responsible for their actions at all times while onsite. They must also ensure that this compliance checklist is signed off by the subcontractor.

WORKERS COMPENSATION: All contractors must be registered with and in good standing with Work Safe BC.

SIGNAGE: English or graphic symbol hazard signage is to be posted on every job site warning workers and visitors of dangers in the area.

TOOL USE: All tools, equipment and machinery are to be provided by the contractor to carry out the tasks of the contracted work. No tools will be loaned for this purpose.

WHMIS / MSDS: Workplace Hazard Management Information System (WHMIS) is to be followed and instructed to all contractor and subcontractor employees. Material Safety Data Sheets (MSDS) are to be supplied prior or at the time all WHMIS regulated material arrives on site.

WASHROOMS: Washrooms are located on all floors. Contractors shall use only assigned washrooms.

WASTE REMOVAL: Unless otherwise specified, materials for removal become the contractor's property and shall be taken from site. No construction waste whatsoever is to be discarded in the building waste removal system(s). This facility is committed to industry best practices with respect to sustainable development of Reduce, Reuse and Recycle. All contractors are encouraged to abide to this whenever possible. Please discuss the possibility of recycling construction materials with the facility / project manager. Recycling centres for glass, cans, paper and cardboard are available throughout the facility for personal use.

WELDING / SOLDERING: Arrangements for written authorisation must be made with Facility / Project Manager a minimum of 48 hours in advance. A "Hot Permit" will be issued following confirmation of specific details and arrangements.

Evacuation Procedures

- If fire alarm sounds, stop what you are doing immediately.
- For contractors working in the crawl space, an additional evacuation signal will be provided using an air horn (two short blasts, one long), as the fire bells are difficult to hear in some areas of the crawl space.
- Shut off electrical equipment if possible.
- Leave the building by the nearest posted fire exit.
- Assemble in the muster area and notify a CFIA employee that you are safe.
- Do not re-enter the premises until instructed by an authorised person that it is safe to do so.

In Case of Fire

- Sound the fire alarm.
- Leave fire area immediately. Do not stop to gather work or personal belongings.
- Call 911 (internal phones dial 8-911)
- Exit building to the muster area.
- Notify a CFIA employee that you have exited as others may be looking for you.
- If hazardous materials have been left behind, advise the CFIA employee who will alert the Fire Department.
- Fire extinguishers are located in key areas of the laboratory facility. Use only if the fire is small and manageable. Do not jeopardise your own or other peoples safety.

Work Safe

- All work requires prior approval from CFIA and a Laboratory Contractor Safety Checklist must be signed.
- Warning signs and isolation barriers must be used when appropriate.
- Plastic poly sheets must be used to protect surfaces and equipment when required by the laboratory.
- Signs must specify the danger if performing welding or other hazardous function.
- Please ask permission if plugging in electrical equipment or unplugging any laboratory equipment.
- Tools must never be left in an overhead work area and areas below must be isolated.
- Aisles and passageways near the work area must not be obstructed by any materials.
- Lock-Out / Tag-Out procedures must be followed where required by regulation.
- You must obtain permission before accessing other areas.

Laboratory Areas

If you are entering the laboratory area, you will be escorted to an assigned area.

- Please do not leave the assigned area without an escort.
- Laboratory Coats/Gowns and Personal Protective Equipment (PPE) must be worn in designated areas. You will be advised what is required. If not provided by your employer, CFIA will provide them.
- Please request permission when taking pictures. We have areas where photographs are not permitted as it will compromise our analyses.
- No open-toed or open-heeled shoes, and we recommend that everyone wear shoes with good traction as there are a lot of wet working areas.
- No food items of any kind (gum, mints, etc.) or beverage is to be brought in laboratory areas.
- Do not place items on work surfaces (pens, paper, etc) to minimise risk of cross-contamination.
- Please wash your hands when entering or exiting laboratory areas. There are hand wash stations and hand disinfectants in all the entrances/exits in all laboratory areas in Microbiology.

Biological Safety

- Biological materials may be found at the facility and may be considered hazardous and can potentially transmit disease.
- Do not touch or remove any biological materials yourself and always ask laboratory staff.
- Decontamination of equipment may be required before being removed from the facility.

Chemical Safety

- Hazardous chemicals are on site for which Material Safety Data Sheets (MSDS) are available. You must consult with the laboratory supervisor before handling or introducing new hazardous chemicals into the facility.

- Eyewash stations are located throughout the facility and some locations have emergency showers. Please ask for nearest location.
- Specific Personal Protective Equipment, required for use when handling chemical hazards, is mandatory. Please consult with the lab for the appropriate equipment.

In Case of Chemical Spill

Do not attempt to clean up the spill yourself. Always inform a laboratory supervisor to determine the appropriate response.

In Case of Chemical Contact

- Call for nearby help immediately.
- Flush eyes or skin with water immediately and continue for at least 15 minutes.
- Remove contaminated clothing as you rinse.

In Case of Injury

- Report all injuries to the laboratory supervisor and to your employer.
- Emergency First Aid can be provided.
- An incident form may need to be completed depending on the injury.
- Accident hazards must be reported to a laboratory supervisor.

Emergency Response Plan Summary

Fire

If you discover a fire, see smoke or smell gas:

- Warn persons nearby and leave the area of danger.
- Activate the nearest fire alarm pull station.
- Fight the fire using an appropriate extinguisher ONLY if you have been trained to do so.
- DO NOT FIGHT A FIRE when:
    - the fire is spreading beyond the spot where it started;
    - you can't fight the fire with your back to an escape exit;
    - the fire can block your only escape;
    - You have the slightest doubt about whether to fight or not to fight.

Evacuation

On steady ringing of the fire alarm, or following air horn blast (two short, one long):

- Turn off equipment as designated for your section and secure information.
- Leave the building using the nearest safe exit, closing all doors behind you.
- Proceed directly to the fire muster area outside, and report to your Area Warden.
- Obey all instructions of the Emergency Wardens and Fire Department or other Emergency Responders.
- DO NOT LEAVE THE MUSTER AREA.
- DO NOT return to the building until you have been given clearance by the Chief Emergency Warden.

Earthquake

- Take immediate shelter under any object that will offer protection against flying glass and debris. Adopt the "crash" position. Move away from windows.
- Stay under cover until the shaking stops. If you are capable of moving and it appears safe to do so, make your way to the BOARD ROOM and report to your Area Warden.
- Do not move injured individuals unless they are in immediate danger. Make a note of their location to pass on to the ERT. If you have an injury that prevents you from moving, stay where you are and await the arrival of emergency personnel.
- If the instruction to evacuate the building is given by the Chief Emergency Warden, using the nearest safe exit, proceed out of the building to the muster area. If the muster area is not safe, seek an open area away from power lines, trees, etc. that might be knocked down during the earthquake and/or its aftershocks. WATCH OUT FOR FALLING DEBRIS. DO NOT attempt to re-enter the building.

Evacuation Cues and Muster Areas

Evacuate the building:	On steady ringing of the fire alarms or following air horn blast (two short, one long)
Evacuation Muster Area:	South sidewalk on Willingdon Green
Earthquake Muster Area:	Ground floor main board room

Contractor Safety Checklist

Contractor Safety Minimum Compliance Requirements

The following checklist is the minimum standard for the orientation of contractors before beginning work in a Canadian Food Inspection Agency Laboratory.

- ☑ There is a designated site contact from the Laboratory Directorate while the contractor is on the site. The Contact will regularly monitor the activities of the contractor.

- ☑ The contractor/service provider acknowledges that all work is to be carried out in a safe and responsible manner and that all practices shall follow both federal and provincial OSH regulations. In case of any discrepancies, the most stringent code shall prevail and be adhered to.

- ☑ The contractor attends a pre-job meeting before work begins and is introduced to the on-site Contact for the Laboratory. This Contact is the person the contractor reports any hazardous occurrences to.

- ☑ The contractor will be given a walk-through of the work areas they will be working in or near, explaining the location and use of emergency eyewash stations, emergency showers, drench hoses, emergency exits, emergency spill kits and their application, fire extinguisher locations, safety board and what to do if they hear the fire evacuation alarm. They must also be given a contact name and phone number in case of an emergency.

- ☑ The contractor must be given a hazard awareness walk-through in their work location(s) to identify any hazards and precautions to be taken.

- ☑ The contractor must be given a thorough review of the security procedures used at the worksite.

- ☑ The contractor reads the safe work procedures for contractors working in a CFIA laboratory and signs the document to indicate they have read and understood it.
- ☑ The contractor must read safe work procedures document for contractors working in a CFIA laboratory. The contractor must also sign a record to indicate that they have read and understood it.

- ☑ For contracts >1 month, the contractor's site supervisor must complete a regular OSH workplace inspection report. A copy shall be given to the CFIA-designated contact.

- ☑ The contractor is required to perform pre-start and job completion OSH workplace inspections of their immediate work area. A report must be given to the CFIA site contact immediately after the inspections are completed.

- ☑ The contractor must supply copies of records of their regular safety meetings, as well as copies of their regular Worker's Compensation Board contributions (as applicable, based on the length of the project).

- ☑ The contractor must have on-site WHMIS/GHS safety data sheets for all materials being used at that site, and provide SDSs to site authorities before chemicals are brought onto the property.

- ☑ Storage of any materials on-site must be authorised by the site contact.
- ☑ If the contract and work involves subcontracting any part of the Scope of Work, a representative from the contractor's firm must accompany any sub trades and be responsible for their actions at all times while on-site. They must also ensure that this compliance checklist is signed off by the subcontractor.
- ☑ Any use of open flames or other hot work like grinding or cutting can only be done with the approval of the site Contact and appropriate Hot Work Permits.
- ☑ If fire occurs as a result of the work, workers must immediately activate the nearest fire alarm pull station. If the fire can be put out safely without danger, then the worker(s) should attempt to extinguish the fire. Report all fires. When a fire bell sounds, all workers must immediately proceed to the nearest point of exit.
- ☑ CFIA laboratories require 48 hours advance notice for taking fire alarm / sprinkler systems off-line.
- ☑ Canadian Food Inspection Agency strictly prohibits smoking on site.
- ☑ Eating and drinking is not permitted in laboratory areas.
- ☑ The use of drugs or alcohol on CFIA facilities is strictly forbidden.

Confidentiality Agreement

Every employee of the Public Service of Canada is required to take an Oath of Office and Secrecy when they are hired. Employees are bound by its requirements to protect confidential information. Employees cannot disclose information about policies, programs, practices or procedures of the Canadian Food Inspection Agency (CFIA) to which the public does not have official access. Employees must also take special care to maintain the confidentiality of any privileged information obtained from CFIA customers regarding their business affairs.

Specific safeguards are identified in the Government Security Policy and Standards and in corresponding departmental or organisational policies which apply to classified and designated information and assets. Classified or designated information and assets must be returned immediately to the appropriate institutional authority when notification is given that the person named herein no longer requires access to such information or assets.

If an individual fails to safeguard, releases without appropriate authority or uses information or assets for unauthorised purposes, such action may constitute a contravention of the Official Secrets Act, the Access to Information Act, the Privacy Act or other Acts of Parliament, a breach of the Government Security Policy or the Oath of the Government of Canada.

As a contractor of Canadian Food Inspection Agency - Burnaby, Willingdon Green Laboratory:

"I, my company and its employees solemnly affirm and declare that we will not, without due authority, disclose or make known any matter that comes to our knowledge by reason of such employment. Once any employment with CFIA concludes, we will continue to respect the confidentiality of any information obtained while working at the CFIA facility."

Contractor Safety, Security and Confidentiality Sign-Off

I acknowledge that I have read, understood, and agree to the terms and conditions of:

- Facility Orientation for Construction and Service Contractors Binder
- Emergency Response Plan Summary
- Canadian Food Inspection Agency Contractor Safety Compliance Checklist
- Confidentiality Agreement
- Canadian Food Inspection Agency Occupational Safety and Health Policy

Company	Name	Date	Reason for Visit	Signature

Part 1 General

1.1 SECTION INCLUDES:

.1 Coordination of Work under administration of Departmental Representative;

.2 Scheduled pre-construction and site meetings;

.3 Project planning and construction schedule;

.4 Site progress monitoring and control.

1.2 DESCRIPTION

.1 Coordinate and manage construction schedule, submittals, use of site, temporary utilities, construction facilities, quality control program, and construction Work, with progress of Work of subcontractors, other contractors and Departmental Representative.

1.3 PRE-CONSTRUCTION MEETING

.1 Within 10 days after award of Contract, Departmental Representative will arrange pre-construction meeting.

.2 Departmental Representative, Contractor and representatives from CFIA will be in attendance.

.3 Departmental Representative will establish time and location of meeting and notify parties concerned.

.4 The Departmental Representative will chair the meeting, record minutes, and issue minutes to all attendees.

.1 Agenda of meeting is generally as follows:

.1 Project team introductions including main construction personnel PWGSC personnel, CFIA representatives, and consultants.

.2 Communication protocol for submittals.

.3 Start date on site.

.5 Construction Organization and Start-up.

.1 Comply with Departmental Representative's allocation of mobilization areas of site; for access, traffic, and parking facilities.

.2 During construction coordinate use of site and facilities through Departmental Representative's procedures for intra-project communications, submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.3 Comply with instructions of Departmental Representative for use of temporary utilities and construction facilities.

.4 Coordinate layout of construction barrier with Departmental Representative.

1.4 PROJECT PLANNING

.1 Plan construction activities, submittals, and field reviews ahead of time for efficient and effective management to ensure timely completion of project.

.2 Contractor to provide two (2) weeks look ahead schedule at every bi-weekly site meeting.

1.5 SCHEDULES

.1 Submit preliminary construction schedule to Departmental Representative during Pre-Construction meeting.

.2 After review, revise and resubmit schedule. Submit final full schedule within two (2) weeks after Pre-Construction meeting.

.3 During progress of Work, revise and resubmit as directed by Departmental Representative.

1.6 CONSTRUCTION SITE MEETINGS

.1 During course of Work and prior to project completion, Departmental Representative will request Construction Site Meetings as required.

.2 Departmental Representative will record minutes of meetings and circulate to attending parties and affected parties not in attendance.

.3 Agenda to include following:

.1 Review and approval of minutes of previous meeting;

.2 Review of Work progress since previous meeting;

.3 Review work to be carried out until the next meeting;

.4 Field observations, problems, conflicts;

.5 Review of Health and Safety including any incidents, near misses, and WorkSafe BC visits;

.6 Problems which impede construction schedule;

.7 Review of off-site fabrication delivery schedules;

.8 Corrective measures and procedures to regain projected schedule;

.9 Revision to construction schedule;

.10 Progress schedule, during succeeding work period;

.11 Review submittal schedules: expedite as required;

.12 Update of Red Line As-Built Drawings;

.13 Maintenance of quality standards;

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

.15 Other business.

1.7 WALK THROUGH FIELD REVIEW BY DEPARTMENTAL REPRESENTATIVE

.1 Departmental Representative will carry out the following:

.1 Walk-through field review of the work with contractor's representatives;

.2 Preparation and distribution of the Walk-through Field Review Reports; Reports will be distributed within five (5) days of field review.

1.8 SUBMITTALS

.1 Submit requests for interpretation of Contract Documents and obtain instructions through Departmental Representative.

.2 Process substitutions through Departmental Representative.

.3 Deliver closeout submittals, for review and inspections, for transmittal to Departmental Representative. Refer also to Section 23 05 00 – Common Work Results for HVAC.

1.9 CLOSEOUT PROCEDURES

.1 Notify Departmental Representative when Work is considered Substantially Complete. Contractor to prepare list of defects, deficiencies, and incomplete work prior to inspection by Departmental Representative. Follow procedures as outlined in Section 01 78 00 – Closeout Submittals.

.2 Accompany Departmental Representative on preliminary inspection to determine items listed for completion or correction.

.3 Comply with Departmental Representative's instructions for correction of items of Work listed in deficiency list.

.4 Notify Departmental Representative of instructions for completion of items of Work determined in Departmental Representative's final inspection.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Schedule and administer site meetings throughout the progress of the work on a regular basis or at the call of Departmental Representative.

.2 Prepare and distribute agenda at least three (3) days prior to the meetings.

.3 Distribute written notice of each meeting seven (7) days in advance of meeting date to Departmental Representative.

.4 Meeting space can be held in the meeting room in CFIA, as coordinated with Departmental Representative. Book meeting or room in advance through Departmental Representative.

.5 Preside at meetings.

.6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.

.7 Reproduce and distribute copies of minutes within five (5) days after meetings and transmit to meeting participants and affected parties not in attendance, Departmental Representative and Consultants.

.8 Representative of Contractor, Sub-contractor, and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRE-CONSTRUCTION MEETING

.1 Within 15 days after award of Contract: Departmental Representative will request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Attendance will include, but is not limited to, the Departmental Representative, CFIA representatives.

.3 Departmental Representative to establish time and location of pre-construction meeting, Contractor to notify parties concerned a minimum of four (4) working days before meeting.

.4 Departmental Representative will chair the meeting, record minutes, and issue minutes.

.5 Agenda to include:

.1 Introduction of official representative of participants in the Work.

.2 Start date on site.

.3 Communication Protocol for submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 51 00 - Temporary Utilities.

.5 EGD Security requirements.

.6 Site safety in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

.7 Communication Protocol for proposed changes, change orders, procedures, approvals required.

.8 Owner's Work.

.9 Record drawings in accordance with Section 01 78 00 - Closeout Submittals.

.10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.

.11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.

.12 Monthly progress claims, administrative procedures, photographs, hold backs.

.13 Appointment of inspection and testing agencies or firms.

1.3 PROGRESS MEETINGS

.1 During course of Work and two weeks prior to Project Completion, schedule progress meetings bi-weekly.

.2 Attendance to include, but is not limited to, Departmental Representative, CFIA representatives, and Contractor.

.3 Contractor responsible to record minutes of meetings and circulate to attending parties and affected parties not in attendance within five (5) days after meeting.

.4 Record next meeting dates in the meeting minutes or notify parties a minimum of seven (7) days in advance for other ad-hoc meetings.

.5 Agenda to include, at a minimum, the following:

.1 Review, approval of minutes of previous meeting;

.2 Review of Health and Safety including any incidents, near misses, and WorkSafe BC visits;

.3 Review of Work progress since previous meeting;

.4 Coordination discussions with CFIA;

.5 Construction schedule review;

.6 Review of off-site fabrication delivery schedules;

.7 Corrective measures and procedures to regain projected schedule;

.8 Request for Information (RFI) log review;

.9 Engineering Disciplines Reviews:

.1 Mechanical,

.2 Electrical;

.3 Structural;

.10 Change order log review;

.11 Review submittal schedule;

.12 Review updated as-builts;

.13 Review and resolve site issues;

.14 New business.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

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

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

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

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

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

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

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

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

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

.11 Do not proceed with work until relevant submissions are reviewed by Departmental Representative.

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

.2 When specified in the Contract document, submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia of Canada.

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

.4 Allow 10 days for Departmental Representative's review of each submission, unless noted otherwise.

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

.6 Make changes in shop drawings as Departmental Representative may require consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

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

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

.8 Submissions to include:

- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontracto,
  - .2 Supplier,
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication;
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances;
  - .3 Setting or erection details;
  - .4 Capacities;
  - .5 Performance characteristics;
  - .6 Standards;
  - .7 Operating weight;
  - .8 Wiring diagrams;
  - .9 Single line and schematic diagrams;
  - .10 Relationship to adjacent work.

.9 After Departmental Representative's review, distribute copies.

.10 Submit electronic copy of shop drawings for each requirement requested in specification sections and as Departmental Representative may reasonably request.

.11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit electronic copies of test reports for requirements requested in specification sections and as requested by Departmental Representative.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within three (3) years of date of contract award for project.

.13 Submit electronic copies of certificates for requirements requested in specification sections and as requested by Departmental Representative.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.14 Submit electronic copies of manufacturer’s instructions for requirements requested in specification sections and as requested by Departmental Representative.

.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit copies of Manufacturer's Field Reports for requirements requested in specification sections and as requested by Departmental Representative.

.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification sections and as requested by Departmental Representative.

.18 Delete information not applicable to project.

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

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

.21 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of Construction and Contract Documents.

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of Work of sub-trades.

.22 Shop drawings format larger than 11" x17" (275mm x 430mm) must be submitted with hardcopies together with electronic format. Submit sufficient copies such that Departmental Representative will be provided with five (5) copies plus contractor's distribution and maintenance manual.

.23 Electronic submissions will only be reviewed and returned electronically. No hardcopies will be returned to contractor.

.24 All electronic submissions to be uploaded to Document Control System FTP site hosted by PWGSC.

1.3 SAMPLES

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

.2 Deliver samples prepaid to Departmental Representative's business address.

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

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

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

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

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

1.4 MOCK-UPS

.1 N/A

1.5 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of colour digital photography in jpg format, standard resolution monthly with progress statement and as directed by Departmental Representative.

.2 Project identification: name and number of project and date of exposure indicated.

.3 Viewpoints and their locations as reasonably determined by Departmental Representative.

.4 Provide photographic documentation of adjacent existing conditions prior to commencement of construction for determining and accidental damage as a result of contractor's work.

.5 Frequency of photographic documentation: monthly as directed by Departmental Representative.

.1 Upon completion of: demolition, framing and services before concealment of Work, and as directed by Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Submit electronic copies of test results and inspection reports required as noted in each section of specifications.

1.7 CLOSEOUT SUBMITTALS

.1 Refer to Section 23 05 00 – Common Work results for HVAC.

END OF SECTION

Part 1 General

1.1 SPECIAL PROCEDURES

.1 All procedures listed in the following section are designed as a minimum standard that the Contractor must achieve, and all work procedures submitted to the Departmental Representative will be reviewed against the following.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 RESTRICTED ACCESS

.1 Areas of the facility are subject to access restrictions.

.2 When access is required to such areas, coordinate with Departmental Representative and follow directions and instructions from Departmental Representative.

3.2 WASTE DISPOSAL PROCEDURE

.1 Requirements

.1 All non-metal and non-glass waste will be transported and disposed of in accordance with the requirements of the Transportation of Dangerous Goods Act, the BC Ministry of Water Lands and Air Protection, and all other applicable regulations.

.2 Any materials stored on site will be stored in an isolated and secure area. The secure area shall be restored to the condition it was before. This area shall be adjacent to the pesticide storage area at the secondary staging area. Contractor shall provide fencing and devices to secure this area.

3.3 ALTERNATIVE PROCEDURES

.1 General Requirements

.1 Procedures described in this specification are to be utilized at all times.

.2 If the specified procedures cannot be utilized, a request must be made in writing to the Departmental Representative providing details of the problems encountered and recommended alternatives.

.3 Alternative procedures shall provide equivalent or greater protection than procedures they replace.

.4 Any alternative procedure must be approved in writing by the Departmental Representative prior to its implementation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Government of Canada:

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

.2 National Building Code of Canada (NBC 2010):

- .1 Part 8, Safety Measures at Construction and Demolition Sites.

.3 Canadian Standards Association (CSA as amended):

- .1 CSA Z797-2009 Code of Practice for Access Scaffold.
- .2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes.
- .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures.

.4 Fire Protection Engineering Services, HRSDC:

- .1 FCC No. 301, Standard for Construction Operations.
- .2 FCC No. 302, Standard for Welding and Cutting.

.5 American National Standards Institute (ANSI):

- .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.6 Province of British Columbia:

- .1 Workers Compensation Act Part 3-Occupational Health and Safety.
- .2 Occupational Health and Safety Regulation.

.7 Current B.C. Electrical Code

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 51 00 - Temporary Utilities.

.3 Section 01 56 00 - Temporary Barriers and Enclosures.

1.3 WORKERS' COMPENSATION BOARD COVERAGE

.1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.

.2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.4 COMPLIANCE WITH REGULATIONS

.1 CFIA may terminate the Contract without liability to CFIA where the Contractor, in the opinion of CFIA, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.

.2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.5 SUBMITTALS

.1 Submit to Departmental Representative submittals listed for review, in accordance with Section 01 33 00.

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

.3 Submit the following:

- .1 Health and Safety Plan;
- .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors;
- .3 Copies of incident and accident reports;
- .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Material Information System (WHMIS) requirements;
- .5 Emergency Procedures.

.4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within two (2) days after Receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

.5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.

.6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:

- .1 Be construed to imply approval by the Departmental Representative.
- .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
- .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6 RESPONSIBILITY

.1 Assume responsibility as the Prime Contractor for work under this contract.

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

.3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable Federal, Provincial, Territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 HEALTH AND SAFETY COORDINATOR

.1 The Health and Safety Coordinator must:

.1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.

.2 Be responsible for implementing, daily enforcing, and monitoring the site-specific Health and Safety Plan.

.3 Be on site during execution of work.

1.8 GENERAL CONDITIONS

.1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.

.2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.

.1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.

.2 Secure site at night time as deemed necessary to protect site against entry.

1.9 REGULATORY REQUIREMENTS

.1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.

.2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

1.10 WORK PERMITS

.1 Obtain specialty trade permits related to project before start of work.

1.11 FILING OF NOTICE

.1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.

.2 Provide copies of all notices to the Departmental Representative.

1.12 HEALTH AND SAFETY PLAN

.1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.

.2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:

.1 Primary requirements:

.1 Contractor's safety policy;

.2 Identification of applicable compliance obligations;

.3 Definition of responsibilities for project safety/organization chart for project;

.4 General safety rules for project;

.5 Job-specific safe work, procedures;

.6 Inspection policy and procedures;

.7 Incident reporting and investigation policy and procedures;

.8 Occupational Health and Safety Committee/Representative procedures;

.9 Occupational Health and Safety meetings;

.10 Occupational Health and Safety communications and record keeping procedures.

.2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.

.3 List hazardous materials to be brought on site as required by work.

.4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.

.5 Identify personal protective equipment (PPE) to be used by workers.

.6 Identify personnel and alternates responsible for site safety and health.

.7 Identify personnel training requirements and training plan, including site orientation for new workers.

.3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.

.4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.

.5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.13 EMERGENCY PROCEDURES

.1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:

- .1 Designated personnel from own company.
- .2 Regulatory agencies applicable to work and as per legislated regulations.
- .3 Local emergency resources.
- .4 Departmental Representative and site staff.

.2 Include the following provisions in the emergency procedures:

- .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
- .2 Evacuate all workers safely.
- .3 Check and confirm the safe evacuation of all workers.
- .4 Notify the fire department or other emergency responders.
- .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
- .6 Notify Departmental Representative and site staff.

.3 Provide written rescue/evacuation procedures as required for, but not limited to:

- .1 Work at high angles.
- .2 Work in confined spaces or where there is a risk of entrapment.
- .3 Work with hazardous substances.
- .4 Underground work.
- .5 Work on, over, under and adjacent to water.
- .6 Workplaces where there are persons who require physical assistance to be moved.

.4 Design and mark emergency exit routes to provide quick and unimpeded exit.

.5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

1.14 HAZARDOUS PRODUCTS

.1 Comply with requirements of Workplace Hazardous Materials Information system (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

.2 Where use of hazardous and toxic products cannot be avoided:

- .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 33 00.
- .2 In conjunction with Departmental Representative, schedule to carry out work during "off hours."

.3 Provide adequate means of ventilation in accordance with Section 01 51 00.

1.15 ASBESTOS HAZARD

.1 In case of discovery of any suspected asbestos containing material during demolition, inform Departmental Representative and, carry out work or demolition activities involving asbestos in accordance with applicable Provincial regulations.

1.16 REMOVAL OF LEAD-CONTAINING PAINTs

.1 All paints containing TCLP lead concentrations above 5 ppm are classified as hazardous.

.2 Carry out demolition activities involving lead-containing paints in accordance with applicable Provincial regulations.

1.17 ELECTRICAL SAFETY REQUIREMENTS

.1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.

.2 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.

.3 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

1.18 ELECTRICAL LOCKOUT

.1 Develop, implement, and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.

.2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.

.3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

1.19 OVERLOADING

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

1.20 CONFINED SPACES

.1 Carry out work in confined spaces in compliance with Occupational Health and Safety Regulation, Part 9.

1.21 POWDER-ACTUATED DEVICES

.1 Use powder-actuated devices in accordance with ANSI A10.3 only after receipt of written permission from the Departmental Representative.

1.22 FIRE SAFETY AND HOT WORK

.1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.

.2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.

1.23 FIRE SAFETY REQUIREMENTS

.1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.24 FIRE PROTECTION AND ALARM SYSTEM

.1 Fire protection and alarm systems shall not be:

.1 Obstructed.

.2 Shut off.

.3 Left inactive at the end of a working day or shift.

.2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.

.3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

1.25 UNFORESEEN HAZARDS

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

1.26 POSTED DOCUMENTS

.1 Post legible versions of the following documents on site:

.1 Health and Safety Plan;

.2 Sequence of work;

.3 Emergency procedures;

.4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions;

.5 Notice of Project;

.6 Floor plans or site plans;

.7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers;

.8 Workplace Hazardous Materials Information System (WHMIS) documents;

.9 Material Safety Data Sheets (MSDS);

.10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.

.2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

.3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.27 MEETINGS

.1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

1.28 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.

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

.3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order."

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 References and Codes.

.2 Discovery of Asbestos (if any).

1.2 PRECEDENCE

.1 Refer to General Conditions clauses.

1.3 REFERENCES AND CODES

.1 Perform Work in accordance with National Building Code of Canada (NBC) including all amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 New construction works shall meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

.3 British Columbia Building Code 2012.

.4 National Building Code of Canada 2010.

.5 National Plumbing Code of Canada 2010.

.6 Labour Canada Code Part II.

.7 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

.8 Occupational Safety and Health Regulations and Standards.

.9 Treasury Board Guidelines.

.10 Health Canada Laboratory Biosafety Guidelines – 2004.

.11 ANSI/AIHA Z9.5-1992 – American National Standard for Laboratory Ventilation.

.12 NFPA 30 - 2012 – Use, handling and storage of flammable and combustible liquids.

.13 NFPA 45 – 2011 – Standard on Fire Protection for Laboratories Using Chemicals.

1.4 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions.

END OF SECTION

Part 1 General

1.1 INSPECTION

.1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

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

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

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

1.2 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative.

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

.3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

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

1.3 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Cooperate to provide reasonable facilities for such access.

1.4 PROCEDURES

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

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

1.5 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental

.2 Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

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

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

1.6 REPORTS

.1 Submit electronic copy of inspection and test reports to Departmental Representative.

.2 Provide copies to subcontractor of work being, inspected or tested or manufacturer or fabricator of material being inspected or tested.

1.7 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested.

.2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.

1.8 MOCK-UPS

.1 N/A.

1.9 MILL TESTS

.1 Submit mill test certificates as requested.

1.10 EQUIPMENT AND SYSTEMS

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

.2 Refer to Divisions 21, 22, 23, 25, and 26 for definitive and specific requirements.

END OF SECTION

Part 1 General

1.1 ACCESS AND DELIVERY

.1 Only the designated entrance may be used for personnel access to the site.

.2 Contractor is required to use only the designated entrance to access the work site, for deliveries to site, and as the exit for offsite disposal.

.1 Maintain for duration of contract.

.2 Make good damage resulting from Contractor's use.

.3 Provide and maintain access roads, sidewalk crossing ramps and construction runways as may be required for access to the work. All roadways and walkways outside of the Contractor's work site must be kept clear of materials and equipment at all times.

.4 Provide and maintain competent flag operators, traffic signals, barricades and flares, lights or lanterns as may be required to perform work and protect other users of the facility.

1.2 CONSTRUCTION PARKING

.1 Construction staff is allowed to park in the designated stalls at the facility parking lot. Departmental Representative will have full discretion of the assignment of the number of stalls. Assigned stalls may not be sufficient to meet construction staff requirement.

1.3 STORAGE FACILITIES

.1 Confine work and operations of employees to areas indicated on Contract Documents. Do not unreasonably encumber premises with products. Storage space to be limited to the area of construction.

.2 Do not load or permit to load any part of Work with weight or force that will endanger Work or existing structure or elements.

.3 Provide and pay for all off-site storage as required. Note that storage space is limited on site.

1.4 POWER

.1 Subject to coordination with Departmental Representative, electrical power within the facility may be used at no extra cost. There is no guarantee of uninterrupted power supply. Contractor will use this power source at their own risk. Contractor will not be compensated for any incurred cost or time owing to any power failure. Contractor will be responsible for other power source as they consider to be required for completing the project. Contractor will be responsible for all the cost of connecting and disconnecting from this power source after completion of project to the satisfaction of the Departmental Representative.

.2 Contractor to supply his own compressed air for the duration of the contract.

1.5 WATER SUPPLY

.1 Water supply is available for use by Contractor.

1.6 SANITARY FACILITIES

.1 Contractor will provide their own portable sanitary facilities. Maintain in a safe and sanitary condition. Construction staff will not be allowed to use the facility washrooms.

1.7 HEATING AND VENTILIATION

.1 Do not begin work until arrangements have been made with the Departmental Representative for protection of on-floor heating, ventilating, and air conditioning.

.2 If there is any dirt in the heating and ventilation system, at the completion of work, resulting from the dust generated by construction activities, it will be the Contractor's responsibility to return system to its original state in accordance with the Departmental Representative's directions.

.3 Prevent dust and odour migration to other occupied areas.

.1 Do not deactivate HVAC system to occupied floors. Purge air from construction floors only when directed by Departmental Representative, where dust and fumes will be generated.

.2 Provide outdoor air intake protection when dust generating construction activities are performed.

1.8 SCAFFOLDING

.1 Construct and maintain scaffolding in rigid, secure and safe manner.

.2 Erect scaffolding independent of walls. Remove promptly when no longer required.

1.9 HOISTING

.1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with sub-contractors for their use of hoists.

.2 Hoists shall be operated by qualified operator.

1.10 HOARDING

.1 Prior to all demolition and construction, install dust proof hoarding or protective barrier to separate construction zone and the rest of the operating facility; maintain in safe and clean condition throughout duration of project. Submit hoarding plan to Departmental Representative for approval.

.2 Erect and maintain safety barricades around all openings and other danger areas as required by Building Code and WCB.

.3 Make good all floor, ceiling and wall to their original condition after removal of hoarding at completion of project.

1.11 SITE OFFICE

.1 Contractor to provide their own trailer as temporary site office. Coordinate with Departmental representative for exact location.

.2 Contractor should clear and demolish site office at end of project according to contract requirement.

1.12 REMOVAL OF TEMPORARY FACILITIES

.1 Remove temporary facilities from site when directed by the Departmental Representative.

1.13 SIGNS AND NOTICES

.1 Signs and notices for safety and instruction shall be in both official languages or graphic symbols conforming to CAN/CSA-Z321.

.2 Maintain approved signs and notices in good condition for duration of Project, and dispose of offsite on completion of Project when directed by Departmental Representative.

1.14 CLEAN-UP

.1 Remove construction debris, waste materials, packaging material from work site daily.

.2 Clean dirt of mud tracked onto paved or surfaced roadways.

.3 Store materials resulting from demolition activities that are salvageable.

.4 Stack stored new or salvaged material not in construction facilities.

.5 At completion of Project, remove and dispose of all debris, thoroughly clean and restore site to condition found at commencement of Work. Repair and make good to all damage caused by construction activities.

1.15 USE OF EXISTING UTILITIES

.1 It is the intention of the Departmental Representative to supply temporary services where specified, however, in the event of any unforeseen occurrence, the Departmental Representative may discontinue such temporary service, without notice, and without acceptance of any liability, for damage or delay, caused by such withdrawal of temporary services.

.2 Supply of temporary services by Department Representative is subject to the requirements of the facility and level of availability of existing services.

.3 Contractor shall bear costs of all temporary services required for the project, subject to approval by Departmental Representative those available from existing services.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 Canadian Standards Association (CSA International)

.1 CSA-O121-M1978 (R2003, Douglas Fir Plywood.

.3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C,' In Effect as of: May 14, 2004.

1.2 INSTALLATION AND REMOVAL

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

.2 Remove from site all such work after use.

1.3 HOARDING

.1 Refer to Section 01 51 00 - Temporary Utilities, Clause 1.10.

1.4 ACCESS TO SITE

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.5 FIRE ROUTES

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

.2 Maintain clearance for all egress routes.

1.6 PROTECTION OF OFF-SITE AND PUBLIC PROPERTY

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

.2 Be responsible for damage incurred.

1.7 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Protect existing operating equipment within the project area.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 PRODUCTS/MATERIAL AND EQUIPMENT

.1 Use NEW products/material and equipment unless otherwise specified. The term "products" is referred to throughout the specifications.

.2 Use products of one manufacturer for material and equipment of the same type or classification unless otherwise specified.

.3 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.4 Notify Departmental Representative in writing of any conflict between these specifications and manufacturer's instructions. Departmental Representative will designate which document is to be followed.

.5 Provide metal fastenings and accessories in the same texture, colour and finish as base metal in which they occur.

- .1 Prevent electrolytic action between dissimilar metals.
- .2 Use non-corrosive fasteners, anchors and spacers for securing exterior work.
- .3 Fastenings which cause spalling or cracking are not acceptable.
- .4 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .5 Use heavy hexagon heads, semi-finished unless otherwise specified.
- .6 Bolts may not project more than 1 diameter beyond nuts.
- .7 Types of washers as follows:
  - .1 Plain type washers: use on equipment and sheet metal;
  - .2 Soft gasket lock type washers: use where vibrations occur;
  - .3 Resilient washers: use with stainless steel.
- .8 Deliver, store, and maintain packaged material and equipment with manufacturer's seals and labels intact.
- .9 Prevent damage, adulteration and soiling of products during delivery, handling and storage. Immediately remove rejected products from site.
- .10 Store products in accordance with suppliers' instructions.
- .11 Touch up damaged factory finished surfaces to Departmental Representative's satisfaction.
  - .1 Use primer or enamel to match original.
  - .2 Do not paint over nameplates.

1.2 QUALITY OF PRODUCTS

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

.2 Defective products will be rejected regardless of previous inspections.

.1 Inspection does not relieve responsibility, but is precaution against oversight or error.

.2 Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Retain purchase orders, invoices and other documents to prove that all products utilized in this Contract meet the requirements of the specifications. Produce documents when requested by the Departmental Representative.

.4 Should any dispute arise as to quality or fitness of products, the decision rests strictly with the Departmental Representative based upon the requirements of the Contract Documents.

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

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

1.3 AVAILABILITY OF PRODUCTS

.1 Immediately upon signing the Contract, review product delivery requirements and anticipate foreseeable supply delays for any items.

.2 If delays in supply of products are foreseeable, notify Departmental Representative of such in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of the work.

.3 In event of failure to notify Departmental Representative at the start of work and should it subsequently appear that the work may be delayed for such reason, the Departmental Representative reserves the right to substitute more readily available products of similar character, at no increase in either the Contract price or the Contract time.

1.4 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the specifications, install or erect products in accordance with the manufacturer's instructions.

.1 Do not rely on labels or enclosures provided with products.

.2 Obtain written instructions directly from the manufacturer.

.2 Notify Departmental Representative in writing of conflicts between the specifications and the manufacturer's instructions so that the Departmental Representative may establish the course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and reinstallation at no increase in either the Contract price or the Contract time.

1.5 CONTRACTOR'S OPTIONS FOR SELECTION OF PRODUCTS FOR TENDERING

.1 Products are specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.

.2 Products specified under "Acceptable Products": select any one of the indicated manufacturers or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.

.3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.

.4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative in accordance with "Special Instructions to Tenderers."

.5 When products are specified by a referenced standard or by or Performance specifications, upon request of Departmental Representative obtain from manufacturer an independent laboratory report showing that the product meets or exceeds the specified requirements.

1.6 SUBSTITUTION AFTER CONTRACT AWARD

.1 No substitutions are permitted without prior written approval of the Departmental Representative.

.2 Proposals for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and the proposed substitution.

.3 Proposals will be considered by the Departmental Representative if:

.1 Products selected by tenderer from those specified are not available.

.2 Delivery date of products selected from those specified would unduly delay completion of Contract, or

.3 Alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.

.4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.

.5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative and the Contract price will be reduced accordingly.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 A set of construction drawings of existing Mechanical Room in PDF format are available for viewing and reference only upon request. The set of drawings may not be full completed set and do not necessarily represent as-built conditions. All existing conditions measurements need to be verified on site.

1.2 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, licensed to practice in the Province of British Columbia, acceptable to Departmental Representative.

1.3 EXISTING SERVICES

.1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.

.2 Contractor is responsible to provide GPR Survey of existing services as required to verify existing underground condition prior to excavation.

1.4 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures, and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturers' recommendations for safety, access, and maintenance.

.3 Inform Departmental Representative of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.5 RECORDS

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles, and elevations of Work.

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

1.6 SUBMITTALS

.1 Submit name and address of Surveyor to Departmental Representative.

.2 On request of Departmental Representative, submit documentation to verify accuracy of field engineering work.

.3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform to Contract Documents.

1.7 SUBSURFACE CONDITIONS

.1 Promptly notify Departmental Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

.2 After prompt investigation, should Departmental Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Submit written request in advance of cutting or alteration which affects:

- .1 Structural integrity of elements of project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Owner or separate contractor.

.3 Include in request:

- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Owner or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

1.2 MATERIALS

.1 Required for original installation.

.2 Change in Materials: submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

Part 2 Execution

2.1 GENERAL

.1 Execute cutting, fitting, and patching, including excavation and fill, to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

.8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.

.9 Restore work with new products in accordance with requirements of Contract Documents.

.10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 - Firestopping, full thickness of the construction element.

.12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

.13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

.14 Provide GPR scan to concrete slab prior to demolition to defect any underslab services.

2.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: 2020, Title: General Conditions. In Effect as Of: April 25, 2013.

1.2 PROJECT CLEANLINESS

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

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

.3 Clear snow and ice from access to building, bank/pile snow in designated areas only.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.7 Dispose of waste materials and debris off site.

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

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 FINAL CLEANING

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

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris including that caused by Owner or other Contractors.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.

.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, millwork floors and ceilings.

.9 Clean lighting reflectors, lenses, and other lighting surfaces.

.10 Vacuum clean and dust building interiors, behind grilles, louvres, and screens.

.11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

.12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.14 Remove dirt and other disfiguration from exterior surfaces.

.15 Clean and sweep gutters.

.16 Sweep and wash clean paved areas.

.17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

.18 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.19 Remove snow and ice from access to buildings.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT GOALS

.1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss PWGSC's Waste Management Plan and Goals.

.2 Accomplish maximum control of solid construction waste.

.3 Preserve environment and prevent pollution and environment damage.

1.2 DEFINITIONS

.1 Class III: non-hazardous waste - construction renovation and demolition waste.

.2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.

.3 Demolition Waste Audit (DWA): relates to actual waste generated from project.

.4 Inert Fill: inert waste - exclusively asphalt and concrete.

.5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.1 Salvaging reusable materials from re-modeling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.2 Returning reusable items including pallets or unused products to vendors.

.10 Salvage: removal of structural and non-structural materials from deconstruction/dis-assembly projects for purpose of reuse or recycling.

.11 Separate Condition: refers to waste sorted into individual types.

.12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

.13 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.

.14 Waste Management Coordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

.15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.3 DOCUMENTS

.1 Maintain at job site, one copy of following documents:

.1 Waste Audit.

.2 Waste Reduction Workplan.

.3 Material Source Separation Plan.

.4 Schedules A, B, C, D, E completed for project.

1.4 SUBMITTALS

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

.2 Prepare and submit following prior to project start-up:

.1 Submit two (2) copies of completed Waste Reduction Workplan (WRW): Schedule B.

.2 Submit two (2) copies of completed Demolition Waste Audit (DWA): Schedule C.

.3 Submit two (2) copies of Materials Source Separation Program (MSSP) description.

.3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.

.1 Failure to submit could result in hold back of final payment.

.2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.

.3 For each material reused, sold or recycled from project, include amount quantities by number, type and size of items and the destination.

.4 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

1.5 WASTE AUDIT (WA)

.1 Conduct WA prior to project start-up.

.2 Prepare WA: Schedule A.

.3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

1.6 WASTE REDUCTION WORKPLAN (WRW)

.1 Prepare WRW prior to project start-up.

.2 WRW should include but not limited to:

.1 Destination of materials listed.

.2 Deconstruction/disassembly techniques and sequencing.

.3 Schedule for deconstruction/disassembly.

.4 Location.

.5 Security.

.6 Protection.

.7 Clear labelling of storage areas.

.8 Details on materials handling and removal procedures.

.9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.

.3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.

.4 Describe management of waste.

.5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.

.6 Post WRW or summary where workers at site are able to review content.

.7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.

.8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

1.7 DEMOLITION WASTE AUDIT (DWA)

.1 Prepare DWA prior to project start-up.

.2 Complete DWA: Schedule C.

.3 Provide inventory of quantities of materials to be salvaged for reuse, recycling, or disposal.

1.8 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

.1 Prepare MSSP and have ready for use prior to project start-up.

.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.

.3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.4 Provide containers to deposit reusable and recyclable materials.

.5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

.6 Locate separated materials in areas which minimize material damage.

.7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

.1 Transport to approved and authorized recycling facility.

1.9 STORAGE, HANDLING AND PROTECTION

.1 Store materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.

.2 Unless specified otherwise, materials for removal become Contractor's property.

.3 Protect surface drainage, mechanical and electrical from damage and blockage.

.4 Separate and store materials produced during dismantling of structures in designated areas.

.5 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

.1 On-site source separation is recommended.

.2 Remove co-mingled materials to off-site processing facility for separation.

.3 Provide waybills for separated materials.

1.10 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

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

.3 Keep records of construction waste including:

.1 Number and size of bins.

.2 Waste type of each bin.

.3 Total tonnage generated.

.4 Tonnage reused or recycled.

.5 Reused or recycled waste destination.

.4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

.5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.11 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises.

.2 Provide temporary security measures approved by Departmental Representative.

1.12 SCHEDULING

.1 Coordinate Work with other activities at site to ensure timely and orderly progress of Work.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 APPLICATION

.1 Do Work in compliance with WRW.

.2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

.1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

.3 Source separate materials to be reused/recycled into specified sort areas.

3.3 DIVERSION OF MATERIALS

.1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Departmental Representative, and consistent with applicable fire regulations.

.1 Mark containers or stockpile areas.

.2 Provide instruction on disposal practices.

.2 On-site sale of salvaged recovered reusable and/or recyclable materials is not permitted.

.3 Demolition Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Acoustical Insulation	100	
Doors and Frames	100	
Electrical Equipment	80	
Mechanical Equipment	100	
Metals	100	
Rubble	100	
Wood (uncontaminated)	100	
Other		

.4 Construction Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Cardboard	100	
Plastic Packaging	100	
Rubble	100	
Steel	100	
Wood (uncontaminated)	100	
Other		

3.4 WASTE AUDIT (WA)

The following pertains to Schedule A - Waste Audit (WA). Column-1 refers to the category of waste, and a physical description of the material (e.g. off-cuts, clean drywall, etc.). Column-2 refers to the total quantity of materials received by the Contractor.

Measurement units must be specified. Column-3 refers to the estimated percentage of material that is waste. Column-4 refers to the total quantity of waste (column-2 x column-3). Column-5 refers to the areas(s) in which the waste was generated. Column-6 refers to the total percentage of recycled material from the specified total quantity of waste (column-4). Column-7 refers to the total percentage of reused material from the specified total quantity of waste (column-4).

.1 Schedule A - Waste Audit (WA):

(1) Material Category	(2) Material Quantity Unit %	(3) Estimated Waste	(4) Total Quantity of Waste (unit)	(5) Generation Point	(6) % Recycled	(7) % Reused
Wood & Plastics						
Material Description						
Off-Cuts						
Warped						
Plastic						
Cardboard						
Other						
Doors & Windows						
Material Description						
Frames						
Glass						
Wood						
Metal						
Other						

3.5

3.6 WASTE REDUCTION WORKPLAN (WRW)

The following pertains to Schedule B - Waste Reduction Workplan (WRW). Column-1 refers to the category and type of waste materials. Column-2 refers to the persons responsible for completing the WRW. Column-3 refers to Column-4 of Schedule A. Column-4 refers to the amount of reused waste predicted and realized. Column-5 refers to the amount of recycled waste predicted and realized. Column-6 refers to the approved recycling facility.

.1 Schedule B:

(1) Material Quantity Category	(2) Person Amount Responsible Waste	(3) Total of Project (units)	(4) Reused Actual (units)	(5) Recycle Actual(s) Amount	(6) Material Destination(s)
Wood & Plastics					
Material Description					
Chutes					
Warped					
Plastic					
Cardboard Packaging					
Other					
Doors & Windows					
Material Description					
Painted					
Frames					
Glass					
Wood					
Metal					
Other					

3.7 DEMOLITION WASTE AUDIT (DWA)

The following pertains to Schedule C - Demolition Waste Audit (DWA). Column-1 refers to the type of material salvaged. Column-2 refers to the material quantity shown in column-1. Several columns may be required to identify specific demolition areas. Column-3 refers to the unit of measurement used to describe Column-2. Column-4 refers to the total quantity of salvaged material. Column-5 refers to the cumulative volume of salvaged material. Column-6 refers to the total weight in kilograms. Column-7 refers to remarks and assumptions made about the specified material.

.1 Schedule C - Demolition Waste Audit (DWA):

(1) Material Description Assumptions	(2) Quantity	(3) Unity	(4) Total	(5) Volume (cum)	(6) Weight (cum)	(7) Remarks & Assumptions
Wood						
Wood						
Stud						
Plywood						
Baseboard -wood						
Door						
Trim-Wood						
Cabinet						
Doors & Windows						
Panel						
Regular						
Slab Regular						
Wood						
Laminate						
Byfold-Closet						
Glazing						

3.8 CANADIAN GOVERMENTAL DEPARTMENTS CHIEF REPSONSIBLITY FOR THE ENVIROMENT

.1 Schedule E - Government Chief Responsibility for the Environment:

.1 Ministry of Environment Lands and Parks
810 Blanshard Street, 4th Floor
Victoria, BC, V8V 1X4
604-387-1161 / 604-356-6464

.2 Waste Reduction Commission Soils and Hazardous Waste
770 South Pacific Blvd, Suite 303
Vancouver, BC, V6B 5E7
604-660-9550 / 604-660-9596

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES:

.1 Administrative procedures preceding preliminary and final inspections of Work.

1.2 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.

1.3 INSPECTION AND DECLARATION

.1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.

.2 Request Departmental Representative's Inspection.

.3 Departmental Representative's Review: Departmental Representative and Contractor will perform review of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

.4 Completion: submit written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Systems are operational and under full automatic operation.

.4 Equipment and systems have been tested, adjusted, and balanced and are fully operational.

.5 Certificates required by authorities having jurisdiction.

.6 Commissioning of all systems: final commissioning reports have been submitted to the Departmental Representative.

.7 Operation of systems has been demonstrated to Owner's personnel.

.8 All Completion Submittals have been finalized.

.9 Work is complete and ready for Final Inspection.

.10 Sprinkler contractor’s final completion and Schedule C.

.11 Seismic Engineer’s final completion and Schedule C.

.12 Refer to Section 23 05 00 – Common Work Results for HVAC.

.2 Submit required forms as described in General Conditions and Standard Acquisition Contract Clause (SACC) manual.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 45 00 - Quality Control.

.2 Section 01 71 00 - Examination and Preparation.

.3 Section 01 77 00 - Closeout Procedures.

.4 Section 01 79 00 - Demonstration and Training.

.5 Section 01 91 31 - General Commissioning (Cx) Requirement.

.6 Section 23 05 00 – Common Work Results for HVAC.

1.2 SUBMISSION

.1 Refer also to Section 23 05 00 – Common Work Results for HVAC.

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

.3 Copy will be returned after final inspection, with Departmental Representative's comments.

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

.5 Two weeks prior to Completion of the Work, submit to the Departmental Representative, four (4) final copies of operating and maintenance manuals in English.

.6 An electronic copy Interactive Operating and Maintenance Manual System is required as specified under clause 1.3. Provide four (4) sets of the Electronic Interactive Operating and Maintenance Manual System to the Departmental Representative.

.7 Hard copies of the Operating and Maintenance Manual System is required as specified under clause 1.4. Provide four (4) sets of the Hard Copy Interactive Operating and Maintenance Manual System to the Departmental Representative.

.8 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work. Refer to individual specification sections for all extra parts, materials, fixtures and equipment required.

.9 If requested, furnish evidence as to type, source and quality of products provided.

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

.11 Pay costs of transportation.

.12 Certificate of Completion.

1.3 INTERACTIVE OPERATING AND MAINTENANCE MANUAL SYSTEM

.1 In addition to the printed copies, submit provide an Interactive Operating and Maintenance Manual System as specified herein.

.2 System Description and Requirements.

.1 All as constructed drawings and operation and maintenance (O&M) manuals listed under the Scope of Work shall be converted, where necessary, into Portable Data File (PDF) format for viewing using the Adobe Acrobat Reader.

.2 Documentation storage and retrieval system shall be structured based on a database framework with direct links to the appropriate PDF files. Documents retrieval and viewing shall be executed through a menu driven approach.

.3 Program shall be capable of storing separately and independently data of multiple buildings and shall be expandable for addition of new buildings and systems.

.4 Data of each building shall be accessible by the input of either the building name or building number as defined by the Departmental Representative.

.5 O&M data and as constructed drawings shall be classified by their corresponding disciplines, including:

.1 Mechanical;

.2 Electrical;

.3 Structural;

.4 EMCS, Data & Communication.

.5 Under each discipline, data shall be grouped into the following four major categories:

.1 Basic Documents:

.1 'Basic Documents' shall, according to the type of services or disciplines, include the full contents of each hard copy of the O&M manuals with the addition of Miscellaneous Maintenance Reports and Records, or as defined by the user. In general the following shall be included unless specifically excluded by the Departmental Representative:

1. Introduction,
2. Consultant/Contractor/Suppliers List,
3. System Description,
4. Maintenance and Lubrication Schedules,
5. Testing and Commissioning (T&C) Reports,
6. Miscellaneous Reports,
7. Specifications,
8. Equipment and/or point schedules as identified in the hard copy documents,
9. Others as stipulated by the Departmental Representative.

.2 All Basic Documents PDF files shall be enhanced with appropriate bookmarks to facilitate searching of information within the document or linking to other relevant documents for references.

.2 'As-Constructed' Drawings

.1 'As-Constructed' drawings shall be converted from the original electronic files, such as CAD, into PDF format. If only the hard

copies of the 'as constructed' drawings are available, they shall be scanned and saved in PDF format. PDF files of the 'As-Constructed' drawings shall be enhanced with the following bookmarks to zoom into legible views on the computer screen as a minimum:

1. Drawing Number and Title;
2. Drawing Notes;
3. Major Equipment Locations;
4. Cross-links to other related drawings;
5. Revisions.

.3 System Data

.1 Building systems shall be identified by their services, disciplines, function, nature and specific scope. System data shall be classified into the following categories:

1. System Description;
2. Schematic (where applicable);
3. Equipment List.

.2 Provide hot key buttons, where applicable, for direct access to drawings/data referenced on the schematics. The same shall be applied to listed equipment for direct links to the corresponding equipment data.

.4 Equipment Data

.1 Equipment data shall be classified into the following categories:

1. Equipment submittals;
2. T&C Report;
3. Maintenance Data;
4. Maintenance Records;
5. Photo.

.2 Provide a summary screen to list all equipment classified under a specific system. On the summary screen, provide direct links to the corresponding equipment data under each category with addition links to the relevant 'As Constructed' drawings.

.6 The system shall be executed by Professional Engineers with a minimum of 10 years' post qualification experience in the field of Building Services Engineering.

.7 The Contractor shall provide a minimum of three (3) past job references as proven record of similar undertakings.

.8 The Contractor shall provide a demonstration of the system to the Departmental Representative to provide verification that the requirements of the specification are fulfilled.

1.4 FORMAT HARD COPY MANUALS

.1 Organize data in the form of an instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

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

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

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

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

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

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

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

1.5 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;

- .1 Date of submission;
- .2 Names, addresses, and telephone and fax numbers of Contractor, Subcontractors, Suppliers with name of responsible parties;
- .3 Schedule of products and systems, indexed to content of volume;
- .4 Copy of hardware schedule and paint schedules, complete with the actual manufacturer, supplier and identification names and numbers;
- .5 All extended guarantees, warranties, maintenance bonds, certificates, letters of guarantees, registration cards, as called for in the various sections of the specification;
- .6 Complete set of all final reviewed shop drawings;
- .7 Certificates of inspection by authorities having jurisdiction;
- .8 Test reports and certificates as applicable;
- .9 Complete set of as constructed drawings.

.2 For each product or system:

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

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

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

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of

instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

.6 Training: refer to Section 01 79 00 - Demonstration and Training.

1.6 'AS CONSTRUCTED' DRAWINGS AND SAMPLES

.1 In addition to requirements in General Conditions, maintain at the site one record copy of:

- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Change Orders and other modifications to the Contract.
- .5 Reviewed shop drawings, product data, and samples.
- .6 Field test records.
- .7 Inspection certificates.
- .8 Manufacturers' certificates.

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

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

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

.5 Keep record documents and samples available for inspection by Departmental Representative.

.6 Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring. Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed. Use different colour waterproof ink for each service.

.7 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings. Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.8 Arrange for and be responsible for the preparation of as-built drawings in AutoCAD computerized drafting system. Be responsible for the cost of preparation of as-built drawings. Submit electronic copy of the as-built drawings on CD/DVD media in CAD and PDF format, as well as 2 sets of hard copies. Submit as-built drawings before requesting Substantial Completion..

1.7 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, provided by Departmental Representative.

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

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

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

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

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

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

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

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

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

.2 Changes made by Addenda and change orders.

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

1.8 EQUIPMENT AND SYSTEMS

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

.1 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.2 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.3 Description of plumbing specialties and accessories, giving manufacturer's name, type, model, year, capacity. List of recommended spare parts.

.3 Performance data to include:

.1 Equipment performance verification test results.

.2 Special performance data as specified.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

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

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

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

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

.8 Include sequence of operation by controls manufacturer.

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

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

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

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

.14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and Section 01 91 13 – General Commissioning (Cx) Requirements.

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

1.9 MATERIALS AND FINISHES

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

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

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

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

1.10 SPARE PARTS

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

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

.3 Deliver to location as directed by Departmental Representative.

.4 Receive and catalogue all items.

.5 Submit inventory listing to Departmental Representative.

.6 Include approved listings in Maintenance Manual.

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

1.11 MAINTENANCE MATERIALS

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

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

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

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in the Operating and Maintenance Manuals.

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

1.12 SPECIAL TOOLS

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

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

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

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

1.13 STORAGE, HANDLING AND PROTECTION

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

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

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

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

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

1.14 WARRANTIES AND BONDS

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

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

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

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

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

.6 Co-execute submittals when required.

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

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two (2) weeks prior to date of substantial performance.

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

.3 Preparation:

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

.2 Verify designated personnel are present.

.3 Ensure equipment has been inspected and put into operation in accordance with each division.

.4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 23 05 93 – Testing, Adjusting, and Balancing Testing for HVAC.

.4 Demonstration and Instructions:

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

.2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.

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

.4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

.5 Time Allocated for Instructions: ensure adequate amount of time required for instruction of each item of equipment or system: refer to Section 01 91 41 – Commissioning Training.

1.2 SUBMITTALS

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

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

.3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

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

.5 Provide electronic & hard copies (refer to Section 01 78 00 - Closeout Submittals) of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

.1 When specified in individual sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

.1 Instruct Owner's personnel.

.2 Provide written report that demonstration and instructions have been completed.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

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

.2 Related Sections:

.1 Section 01 33 00 – Submittal Procedures.
.2 Section 01 45 00 – Quality Control.
.3 Section 01 91 31 – Commissioning (Cx) Plan.
.4 Section 23 05 00 – Common Work Results – Mechanical.
.5 Section 23 05 93 – Testing, Adjusting and Balancing Testing, for HVAC.
.6 Section 23 08 01 – Performance Verification Mechanical Piping Systems.
.7 Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.
.8 Section 25 05 01 – EMCS General Requirements.
.9 Section 26 05 00 – Common Work Results - Electrical.
.10 Section 26 12 16 – Dry Type Transformers

.3 Acronyms:

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

1.2 REFERENCE

.1 Public Works and Government Services Canada (PWGSC)

.1 PWGSC-Commissioning Manual CP.1 - 2013.

.2 ANSI/NETA

.1 ANSI/NETA Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems.

.3 CSA

.1 CSA Z320-11 Building Commissioning Standard.

1.3 GENERAL

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

- .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
- .2 Complete Cx for each phase of the work.
- .3 Ensure appropriate documentation is compiled into the BMM.
- .4 Effectively train O&M staff.

.2 This section is included for reference. Retain services of an independent contractor as Commissioning Authority, to oversee the commissioning process, and to perform the commissioning tasks of the mechanical systems. Commissioning of the electrical systems is to be undertaken by the electrical contractor, their suppliers and appropriate sub-trades. The Contractors are required to participate and provide all required manpower and specialized services to ensure the equipment supplied by the contractor meets the contract requirements. Duties of the Commissioning Authority do not relieve the contractor from providing equipment and systems that meet the design intent and specifications. It is not intended that this work shall, in any way, replace normal factory start-up service for equipment or relieve the contractor or his sub-trades of their responsibility for providing systems and equipment in satisfactory working order.

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

- .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
- .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

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

1.4 COMMISSIONING OVERVIEW

.1 Section 01 91 31 - Commissioning (Cx) Plan.

.2 For Cx responsibilities refer to Commissioning (Cx) Plan.

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

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

.5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate

satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

.6 Departmental Representative will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.

.2 Equipment, components and systems have been commissioned.

.3 O&M training has been completed.

1.5 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Departmental Representative, Departmental Representative to ensure effective performance.

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

1.6 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to Departmental Representative.

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have completed Cx Plan up-to-date.

.2 Ensure installation of related components, equipment, sub-systems, systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

.5 Understand completely design criteria and intent and special features.

.6 Submit complete start-up documentation to Departmental Representative.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.

.10 Submit factory testing report of Electrical Equipment to Departmental Representative for review and approval.

.11 Ensure "As-Built" system schematics are available.

.12 Conduct coordination and protection study of upstream breakers, as indicated in drawings, to determine if trip settings are adequate for additional demand. Determine trip setting adjustments and where required re-set breakers accordingly. The study shall be performed at both 12.5 kV and 25 kV distribution voltages.

.13 Factory test each transformer, switchgear assembly, and motor controller assembly and all accessories. Notify Departmental Representative seven (7) days in advance of tests and confirm two (2) days in advance. Departmental Representative and Engineer will attend/witness tests. Tests must be conducted in the Lower Mainland area of British Columbia. Alternatively, if tests are conducted elsewhere, pay the costs of travel time (at $130/hour) and all travel/living expenses for two attendees (at actual cost) associated with Departmental Representative's and engineer's attendance at factory tests and at repeat tests if necessary.

.4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.7 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.

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

1.8 SUBMITTALS

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

.1 Submit no later than four (4) weeks after award of Contract:

.1 Name of Contractor's Cx agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

.2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least eight (8) weeks prior to start of Cx.

.3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least eight (8) weeks prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by Departmental Representative, specifically;

.1 Cx Plan and Schedule

.2 Accepted Shop drawings

.3 Completed PI forms

.4 Approved TAB report

.5 Approved PV forms

.6 Approved O&M manuals

.7 Approved System and Integrated System Test Report

.8 Approved Training and Attendance forms

.9 Accepted "As-built" Plans and Specifications

1.9 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.

.2 General Contractor to review and approve Cx documentation submitted by Cx Agent prior to submission to Departmental Representative for review.

.3 Provide completed and approved Cx documentation to Departmental Representative.

1.10 COMMISSIONING SCHEDULE

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

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

.1 Approval of Cx reports.

.2 Verification of reported results.

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

.4 Training.

1.11 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings: as specified herein.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

.4 At 60% construction completion stage, General Contractor to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

.1 Review duties and responsibilities of General Contractor and subcontractors, addressing delays and potential problems.

.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by General Contractor with their Commissioning Agent, who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.12 STARTING AND TESTING

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

1.13 WITNESSING OF STARTING AND TESTING

.1 Provide 14 days' notice prior to commencement.

.2 Commissioning Authority to witness of start-up and testing (for every phase of the work).

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

.1 Minimum of 5 years' experience in design, installation, and operation of equipment and systems.

.2 Ability to interpret test results accurately.

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

1.14 PROCEDURES

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

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

.1 Included in delivery and installation:

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

.2 Visual inspection of quality of installation.

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

.3 Operational testing: document equipment performance.

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

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

.3 Correct deficiencies and obtain approval from Departmental Representative and Commissioning Authority after distinct phases have been completed and before commencing next phase.

.4 Document required tests on approved PV forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Commissioning Authority. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: implement corrective measures approved by Commissioning Authority.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Commissioning Authority.

.3 If evaluation report concludes that major damage has occurred, Departmental Representative and Commissioning Authority shall reject equipment.

.1 Rejected equipment to be removed from site and replace with new.

.2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

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

.2 Start-up documentation to include:

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

.2 Pre-start-up inspection reports;

.3 Signed installation/start-up check lists;

.4 Start-up reports;

.5 Step-by-step description of complete start-up procedures, to permit Commissioning Authority to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

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

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

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

.4 After completion of commissioning, operate and maintain systems until issuance of Certificate of Substantial Performance.

1.17 TEST RESULTS

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

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

1.18 START OF COMMISSIONING

.1 Notify Commissioning Authority at least 4 weeks prior to start of Cx.

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

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to Commissioning Authority for review and approval:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date, and calibration accuracy.

.2 Provide the following equipment as required:

.1 2-way radios;

.2 Ladders;

.3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under accepted simulated operating conditions, over entire operating range, in all modes;

.2 On independent systems and interacting systems.

.2 Cx procedures to be repeatable and reported results are to be verifiable.

.3 Follow equipment manufacturers' operating instructions.

.4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

.1 Commissioning Authority to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

.1 Where start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies to Commissioning Authority within 5 days of test and with Cx report.

1.23 EXTRAPOLATION OF RESULTS

.1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

.2 Conduct Cx re-visit at the start of the first heating and first cooling season, to confirm performance, set-points, operating logs, etc.

1.24 EXTENT OF VERIFICATION

.1 Building:

.1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.

.2 Number and location to be at discretion of Departmental Representative and Commissioning Authority.

.3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

1.25 REPEAT VERIFICATIONS

.1 Assume costs incurred by Departmental Representative and Commissioning Authority for third and subsequent verifications where:

.1 Verification of reported results fail to receive Departmental Representative's or Commissioning Authority's approval.

.2 Repetition of second verification again fails to receive approval.

.3 Departmental Representative or Commissioning Authority deems Contractor's request for second verification was premature.

1.26 SUNDRY CHECKS AND ADJUSTMENTS

.1 Make adjustments and changes which become apparent as Cx proceeds.

.2 Perform static and operational checks as applicable and as required.

1.27 DEFICIENCIES, FAULTS, DEFECTS

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

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

1.28 COMPLETION OF COMMISSIONING

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

.2 Except for warranty and seasonal verification activities, complete Cx prior to issuance of Certificate of Substantial Performance.

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

1.29 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.30 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.31 OCCUPANCY

.1 Cooperate fully with Departmental Representative and Commissioning Authority during stages of acceptance and occupancy of facility.

1.32 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and PV if:

.1 Accuracy complies with these specifications;

.2 Calibration certificates have been deposited with Departmental Representative.

.2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.33 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.

.2 Instrument accuracy tolerances:

.1 To be of higher order of magnitude than equipment or system being tested.

.3 Measurement tolerances during verification:

.1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.34 OWNER'S PERFORMANCE TESTING

.1 Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

.1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

1.2 REFERENCES

.1 American Water Works Association (AWWA)

.2 CSA

.1 CSA Z320-11 Building Commissioning Standard.

.3 Underwriters' Laboratories of Canada (ULC)

1.3 GENERAL

.1 Provide fully functional facilities:

.1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.

.2 Facility user and O&M personnel have been fully trained in aspects of installed systems.

.3 Optimized life cycle costs.

.4 Complete documentation relating to installed equipment and systems.

.2 Term "Cx" in this section means "Commissioning".

.3 Use this Cx Plan as master planning document for Cx:

.1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.

.2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.

.3 Sets out deliverables relating to O&M, process and administration of Cx.

.4 Describes process of verification of how built works meet design requirements.

.5 Produces a complete functional system prior to issuance of Certificate of Substantial Performance.

.6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:

.1 Overview of Cx.

.2 General description of elements that make up Cx Plan.

.3 Process and methodology for successful Cx.

.4 Acronyms:

.1	Cx	Commissioning.
.2	BMM	Building Management Manual.
.3	EMCS	Energy Monitoring and Control Systems.
.4	MSDS	Material Safety Data Sheets.
.5	PI	Product Information.
.6	PV	Performance Verification.
.7	TAB	Testing, Adjusting and Balancing.
.8	WHMIS	Workplace Hazardous Materials Information System.

.5 Commissioning terms used in this Section:

.1 Bumping: short term start-up to prove ability to start and prove correct rotation.

.2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.4 DEVELOPMENT OF 100% CX PLAN

.1 Cx Plan to be 100% completed within 4 weeks of award of contract to take into account:

.1 Approved shop drawings and product data.

.2 Approved changes to contract.

.3 Contractor's project schedule.

.4 Cx schedule.

.5 Contractor's, sub-contractors', suppliers' requirements.

.6 Project construction team's and Cx team's requirements.

.7 Phasing Requirements.

.2 Cx Authority to review and submit completed Cx Plan to Departmental Representative and obtain written approval.

1.5 REFINEMENT OF CX PLAN

.1 During construction phase, revise, refine and update Cx Plan to include:

.1 Changes resulting from Client program modifications.

.2 Approved design and construction changes.

.2 Revise, refine and update every two (2) months during construction phase. At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.

.4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.6 COMPOSITION, ROLES AND RESPONSIBLITIES OF CX TEAM

.1 Departmental Representative to maintain overall responsibility for project and is sole

point of contact between members of commissioning team.

.2 Project Manager will select Cx Team consisting of following members:

.1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.

.2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:

.1 Review of Cx documentation from operational perspective.

.2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.

.3 Protection of health, safety and comfort of occupants and O&M personnel.

.4 Monitoring of Cx activities, training, development of Cx documentation.

.5 Work closely with members of Cx Team.

.3 Cx Authority is responsible for:

.1 Organizing Cx.

.2 Monitoring operations Cx activities.

.3 Witnessing, certifying accuracy of reported results.

.4 Witnessing and certifying TAB and other tests.

.5 Developing BMM.

.6 Ensuring implementation of final Cx Plan.

.7 Performing verification of performance of installed systems and equipment.

.8 Implementation of Training Plan.

.4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:

.1 Testing.

.2 TAB.

.3 Performance of Cx activities.

.4 Delivery of training and Cx documentation.

.5 Assigning one person as point of contact with Consultant and PWGSC Cx Manager for administrative and coordination purposes.

.5 Contractor's Cx agent implements specified Cx activities including:

.1 Demonstrations.

.2 Training.

.3 Testing.

.4 Preparation, submission of test reports.

.6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:

.1 Receiving facility.

.2 Day-To-Day operation and maintenance of facility.

1.7 EXTENT OF CX

.1 The General Contractor shall provide commissioning services for the following items.

.1 List of Mechanical Equipment and Acceptance Tests:

.1 Domestic water system (including water heaters)

.2 Cooling tower & associated pumps and condenser water system

.3 Room air conditioner systems

.4 BMS (controls) Operator Workstation (software)

.5 Mechanical system in chemical storage building

.2 List of Electrical Equipment and Acceptance Tests:

.1 Dry Type Transformer

.2 Low Voltage lighting Control

.3 MCC

.4 Telecommunication System (Cabling, raceway & rack)

.5 Certificates and/or Equipment Test Report

.6 Equipment Spare Parts Report

.7 Generic Acceptance Report

.8 Twelve Step Final Acceptance Report

1.8 DELIVERABLES RELATING TO O&M PERSPECTIVES

.1 General requirements:

.1 Compile English documentation.

.2 Documentation to be computer-compatible format ready for inputting for data management.

.2 Provide deliverables:

.1 Warranties.

.2 Project record documentation.

.3 Inventory of spare parts, special tools and maintenance materials.

.4 Maintenance Management System (MMS) identification system used.

.5 WHMIS information.

.6 MSDS data sheets.

.7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.9 DELIVERABLES RELATING TO THE CX PROCESS

.1 General:

.1 Start-up, testing, and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.

.2 Definitions:

.1 Cx as used in this section includes:

.1 Cx of components, equipment, systems, subsystems, and integrated systems;

.2 Factory inspections and performance verification tests.

.3 Deliverables: provide:

.1 Cx Specifications;

.2 Start-up, pre-Cx activities and documentation for systems, and equipment;

.3 Completed installation checklists (ICL);

.4 Completed product information (PI) report forms;

.5 Completed performance verification (PV) report forms;

.6 Results of Performance Verification Tests and Inspections;

.7 Description of Cx activities and documentation;

.8 Description of Cx of integrated systems and documentation;

.9 Tests witnessed by Departmental Representative and Cx Authority;

.10 Training Plans;

.11 Cx Reports;

.12 Prescribed activities during warranty period.

1.10 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

.1 General:

.1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.

.2 Definitions:

.1 Cx as used in this section includes:

.1 Cx of components, equipment, systems, subsystems, and integrated systems.

.2 Factory inspections and performance verification tests.

.3 Deliverables: provide:

.1 Cx Specifications;

.2 Startup, pre-Cx activities and documentation for systems, and equipment;

.3 Completed installation checklists (ICL);

.4 Completed product information (PI) report forms;

.5 Completed performance verification (PV) report forms;

.6 Results of Performance Verification Tests and Inspections;

.7 Description of Cx activities and documentation;

.8 Description of Cx of integrated systems and documentation;

.9 Tests of following witnessed by PWGSC Design Quality Review Team;

.10 Tests performed by Owner/User;

.11 Training Plans;

.12 Cx Reports;

.13 Prescribed activities during warranty period;

.4 Cx Authority to witness and certify tests and reports of results provided to Departmental Representative.

.5 Departmental Representative to participate.

1.11 START-UP

.1 Start-up components, equipment and systems.

.2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:

.3 Cx Authority to monitor some of these start-up activities.

.1 Rectify start-up deficiencies to satisfaction of Cx Authority.

.4 Performance Verification (PV):

.1 Approved Cx Agent to perform.

.1 Repeat when necessary until results are acceptable to Cx Authority.

.2 Use procedures modified generic procedures to suit project requirements.

.3 Cx Authority to witness and certify reported results using approved PI and PV forms.

.4 Cx Authority to approve completed PV reports and provide to Departmental Representative.

.5 Cx Authority reserves the right to verify up to 30% of reported results at random.

.6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.12 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx by specified Cx Agent using procedures developed by Cx Authority and approved by Departmental Representative.

.2 Cx Authority to monitor Cx activities.

.3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.

.4 Cx Authority to witness, certify reported results of, Cx activities and forward to Departmental Representative.

.5 Cx Authority reserves the right to verify a percentage of reported results at no cost to contract.

1.13 CX INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed by specified Cx Agent using procedures developed by Cx Authority and approved by Departmental Representative.

.2 Tests to be witnessed by Cx Authority and documented on approved report forms.

.3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Cx Authority and submitted to Departmental Representative for review.

.4 Cx Authority reserves the right to verify percentage of reported results.

.5 Integrated systems to include:

.1 Integrated HVAC systems.

.2 Fire alarm systems.

.3 Emergency power generator.

.4 Transfer switch and controllers.

.6 Identification:

.1 In later stages of Cx, before hand-over and acceptance, Cx Authority, Contractor, Project Manager, Property Manager, and Cx Manager to cooperate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems.

1.14 INSTALLATION CHECK LISTS (ICL)

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.15 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.16 PERFORAMNCE VERIFICATION (PV) REPORT

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.17 DELIVERABLES RELATING TO ADMINISTRATION OF CX

.1 General:

.1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.18 CX SCHEDULES

.1 Prepare detailed Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:

.1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:

.1 Design criteria, design intents.

.2 Pre-TAB review: 28 days after contract award, and before construction starts.

.3 Cx agents' credentials: 60 days before start of Cx.

.4 Cx procedures: three (3) months after award of contract.

.5 Cx Report format: three (3) months after contract award.

.6 Discussion of heating/cooling loads for Cx: three (3) months before start-up.

.7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.

.8 Notification of intention to start TAB: 21 days before start of TAB.

.9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.

.10 Notification of intention to start Cx: 14 days before start of Cx.

.11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.

.12 Identification of deferred Cx.

.13 Implementation of training plans.

.14 Cx reports: immediately upon successful completion of Cx.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.

.3 Six (6) months in Cx schedule for verification of performance in all seasons and wear conditions.

.2 After approval, incorporate Cx Schedule into Construction Schedule.

.3 Consultant, Contractor, Contractor's Cx agent, Cx Authority, and Departmental Representative will monitor progress of Cx against this schedule.

1.19 CX REPORTS

.1 Submit reports of tests, witnessed and certified by the Cx Authority, to Departmental Representative who will verify reported results.

.2 Include completed and certified PV reports in properly formatted Cx Reports.

.3 Before reports are accepted, reported results to be subject to verification by Cx Authority.

1.20 ACTIVITIES DURING WARRANTY PERIOD

.1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:

.1 Fine tuning of HVAC systems.

.2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.

.3 Full-scale emergency evacuation exercises.

1.21 TESTS TO BE PERFORMED BY OWNER/USER

.1 None is anticipated on this project.

1.22 TRANING PLANS

.1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

1.23 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of the Cx Authority and the Departmental Representative, lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

.1 Commissioning forms to be completed for equipment, system and integrated system.

.2 Related Requirements

.1 Section 01 91 13 - General Commissioning (Cx) Requirements

.2 Section 01 91 31 – Commissioning (Cx) Plan

.3 Section 01 91 41 – Commissioning Training

.4 Section 01 91 51 – Building Management Manual (BMM)

1.2 RELATED WORKS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 INSTALLATION/START- UP CHECK LISTS

.1 Include the following data:

.1 Product manufacturer's installation instructions and recommended checks;

.2 Special procedures as specified in relevant technical sections;

.3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

.2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists will be required for specific project conditions.

.3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.

.4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Cx Authority. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) at completion of project.

.5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.4 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines, and pertinent technical data and recommended checks that are necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM at completion of work.

.2 Prior to Performance Verification (PV) of systems, complete items on PI forms related to systems and obtain Departmental Representative's approval.

1.5 PERFORMANCE VERIFICATION (PV) FORMS

.1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.

.2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.

.3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.

1.6 COMMISSIONING FORMS

.1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.

.2 Strategy for Use:

.1 Contractor provides project-specific Commissioning forms with Specification data included.

.2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.

.3 Confirm operation as per design criteria and intent.

.4 Identify variances between design and operation and reasons for variances.

.5 Verify operation in specified normal and emergency modes and under specified load conditions.

.6 Record analytical and substantiating data.

.7 Verify reported results.

.8 Form to bear signatures of recording technician.

.9 Submit immediately after tests are performed.

.10 Reported results in true measured SI unit values.

.11 Provide Departmental Representative with originals of completed forms.

.12 Maintain copy on site during start-up, testing, and commissioning period.

.13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section 01 91 51 - Building Management Manual (BMM).

1.7 LANGUAGE

.1 To suit the language profile of the awarded contract.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

.1 This Section specifies roles and responsibilities of Commissioning Training.

.2 Related Sections:

.1 Section 01 91 13 - General Commissioning (Cx) Requirements

.2 Section 01 91 31 - Commissioning Plan

.3 Section 01 91 33 - Commissioning Forms

1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility (includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required).

.2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.3 INSTRUCTORS

.1 Engineer will provide:

.1 Descriptions of systems;

.2 Instruction on design philosophy, design criteria, and design intent.

.2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:

.1 Start-Up, operation, shut-down of equipment, components and systems;

.2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices;

.3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:

.1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:

.1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions;

.2 Effective on-going inspection, measurements of system performance;

.3 Proper preventive maintenance, diagnosis and trouble-shooting;

.4 Ability to update documentation;

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:

- .1 "As-Built" Contract Documents;
- .2 Operating Manual;
- .3 Maintenance Manual;
- .4 Management Manual;
- .5 TAB and PV Reports.

.3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.

.4 Training materials to be in a format that permits future training procedures to same degree of detail.

.5 Supplement training materials:

- .1 Transparencies for overhead projectors;
- .2 Multimedia presentations;
- .3 Manufacturer's training videos;
- .4 Equipment models;

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 8 hours in length.

.3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

.1 Be responsible for:

- .1 Implementation of training activities,
- .2 Coordination among instructors,
- .3 Quality of training, training materials.

.2 Commissioning Authority will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by Commissioning Authority.

1.8 MECHANICAL SYSTEM TRAINING

.1 Organize and conduct training courses to instruct the Departmental Representative in the operation and preventative maintenance of equipment and systems provided at the completion of the project.

.2 Provide services of qualified personnel, including each sub-trade, each major equipment supplier and design engineer to and instruct on their equipment or systems.

.3 One-person day shall be eight (8) hours including one half hour for breaks, and one person week shall be five (5) person days.

.4 Submit sessions schedule and list of representatives to the Departmental Representative for approval 30 days prior to course starting date. Confirm attendance of course by written notification to all participants, followed by verbal confirmation just prior to course starting date.

.5 Submit final copies of record drawings and operating and maintenance manuals to Departmental Representative.

.6 Submit a written follow-up of all courses, complete with an attendants list to the Departmental Representative.

.7 Systems Course: allow a minimum of eight (8) hours of instruction to conduct systems training courses addressing the following topics:

.1 Cooling Systems:

.1 Review operation of system and equipment

.2 Review condensing unit and maintenance

.3 Review system maintenance.

.4 Cooling system site tour.

.5 Demonstrate start/stop.

.1 Auto control.

.2 Maintenance.

.2 Plumbing:

.1 Review system operation equipment.

.2 Review equipment maintenance including:

.1 Domestic water

.2 Fixtures

.3 Site Services:

.1 Sanitary/storm/domestic water.

.8 Controls Course: Allow a minimum of 8 hours of instruction and an additional 8 hours of instructions to conduct the controls systems training courses as follows:

.1 Provide the services of competent instructors who will give instruction to designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment and system specified. The training shall be specifically for the system installed rather than being a general "canned" training course. The Departmental Representative shall have the right to approve/reject the instructors based on their qualifications. All equipment and material required for classroom training shall be provided by the General Contractor.

.2 Training Program: provide in two phases over a 6 month period, the time interval specified for each phase.

.1 First phase: this phase shall be for a period of 1 day prior to the 30 day test period. Operating personnel will be trained in the functional

operations of the system installed and the procedures that the operators will employ for system operation. First phase training shall include the following:

.1 General EMCS Architectural (overview);

.2 System Communications (overview);

.3 Operation of computer and peripherals (overview);

.4 Operator Interface functions for control of HV AC systems (detailed);

.5 Control Logic (detailed for each system);

.6 Report Generation (overview);

.7 Colour graphics generation;

.8 Elementary preventive maintenance (detailed).

.2 Second Phase: this phase of training shall be conducted eight weeks after system acceptance for a period of one day. Training will be provided for three categories of personnel: operators, equipment maintenance personnel. The training shall include as a minimum, but not be limited to:

.1 Operator Training and Equipment Maintainer's Training include:

1. General equipment layout.
2. Troubleshooting of all EMCS components.
3. Preventive maintenance of all EMCS components.
4. Sensors and controls maintenance and calibration

1.9 ELECTRICAL SYSTEM TRAINING

.1 Organize and conduct training courses to instruct the Departmental Representative in the operation and preventative maintenance of equipment and systems provided at the completion of the project.

.2 Provide services of qualified personnel, including each sub-trade, each major equipment supplier and design engineer to and instruct on their equipment or systems.

.3 One-person day shall be eight (8) hours including one half hour for breaks, and one person week shall be five (5) person days.

.4 Submit sessions schedule and list of representatives to the Departmental Representative for approval 30 days prior to course starting date. Confirm attendance of course by written notification to all participants, followed by verbal confirmation just prior to course starting date.

.5 Submit final copies of record drawings and operating and maintenance manuals to Departmental Representative. Submit a written follow-up of all courses, complete with an attendants list to the Departmental Representative.

.6 Systems Course: Allow a minimum of eight (8) hours of instruction to conduct systems training courses addressing the following topics:

.1 Standard Power Systems:

.1 Review operation of systems and equipment.

.2 Communications Pedestals:

.1 Review operation of systems and equipment.

.3 Fire Alarm Equipment:

.1 Review operation of systems and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

.1 This section is limited to portions of the Building Management Manual (BMM) provided to Departmental Representative by Contractor.

.2 Related Requirements

.1 Section 01 78 00 – Closeout Submittals

.3 Acronyms:

.1	BMM	Building Management Manual
.2	Cx	Commissioning
.3	HVAC	Heating, Ventilation, and Air Conditioning
.4	PI	Product Information
.5	PV	Performance Verification
.6	TAB	Testing, Adjusting, and Balancing
.7	WHMIS	Workplace Hazardous Materials Information System

1.2 GENERAL REQUIREMENTS

.1 Standard letter size paper 216 mm x 279 mm.

.2 Methodology used to facilitate updating.

.3 Drawings, diagrams, and schematics to be professionally developed.

.4 Electronic copy of data to be in a PDF with hyperlink from content page to individual sections.

1.3 APPROVALS

.1 Prior to commencement, coordinate requirements for preparation, submission, and approval with Departmental Representative.

1.4 GENERAL INFORMATION

.1 Provide Departmental Representative the following for insertion into appropriate Part and Section of BMM:

.1 Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.

.2 Summary of architectural, structural, fire protection, mechanical, and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.

.1 Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.

.3 Description of building operation under conditions of heightened security and emergencies as indicated in Section 2.0 of BMM.

.4 System, equipment, and components Maintenance Management System (MMS) identification - Section 2.1 of BMM.

.5 Information on operation and maintenance of architectural systems and equipment installed and commissioned - Section 2.0 of BMM.

.6 Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.

.7 Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.

.8 Operating and maintenance manual - Section 3.2 of BMM.

.9 Final commissioning plan as actually implemented.

.10 Completed commissioning checklists.

.11 Commissioning test procedures employed.

.12 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Departmental Representative.

.13 Commissioning reports.

1.5 CONTENTS OF OPERATING AND MAINTENANCE MANUAL

.1 For detailed requirements refer to Section 01 78 00 - Closeout Submittals.

.2 Departmental Representative to review and approve format and organization within 12 weeks of award of contract.

.3 Include original manufacturers' brochures and written information on products and equipment installed on this project.

.4 Record and organize for easy access and retrieval of information contained in BMM.

.5 Include completed PI report forms, data, and information from other sources as required.

.6 Inventory directory relating to information on installed systems, equipment, and components.

.7 Approved project shop drawings, product and maintenance data.

.8 Manufacturers' data and recommendations relating to: manufacturing process, installation, commissioning, start-up, O&M, shutdown, and training materials.

.9 Inventory and location of spare parts, special tools, and maintenance materials.

.10 Warranty information.

.11 Inspection certificates with expiration dates, which require on-going re-certification inspections.

.12 Controls record drawings

.13 Maintenance program supporting information including:

.1 Recommended maintenance procedures and schedule;

.2 Information to removal and replacement of equipment including, required equipment, points of lift, and means of entry and egress.

1.6 LIFE SAFETY COMPLIANCE (LSC) MANUAL

.1 Samples of LSC Manual will be available from Departmental Representative.

.2 Content of Manual:

.1 All possible emergency situations modes, including: presence of fire and smoke, power failure, loss of water or pressure, chemical spills, and refrigerant release;

.2 HVAC emergencies and fuel supply failures;

.3 Intrusion and security breach;

.4 Emergency provisions for natural disasters, bomb threats, and other disruptive situations;

.5 Dedicated emergency generators for high security projects, medical facilities, and computer systems;

.6 Emergency control procedures for fire, power, and major equipment failure.

.7 Emergency contacts and numbers;

.8 Manual to be readily available and comprehensible to non- technical readers.

1.7 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES

.1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:

.1 General:

.1 Finalized commissioning plan;

.2 WHMIS information manual;

.3 Approved "as-built" drawings and specifications;

.4 Procedures used during commissioning;

.5 Cross-reference to specification sections.

.2 Architectural and Structural:

.1 Inspection certificates, construction permits;

.2 PV reports.

.3 Fire prevention, suppression and protection:

.1 Test reports;

.2 Smoke test reports;

.3 PV reports.

.4 Mechanical:

.1 Installation permits, inspection certificates;

.2 Piping pressure test certificates;

.3 TAB and PV reports;

.4 Charts of valves and steam traps;

.5 Copies of posted instructions.

.6 System description and description of system operation for each system.

.5 Electrical:

.1 Installation permits, inspection certificates;

.2 TAB and PV reports;

.3 Electrical work log book;

.4 Charts and schedules;

.5 Locations of cables and components;

.6 Copies of posted instructions.

.2 Provide hard copies and electronic, searchable PDF Format.

.3 Assist Departmental Representative with preparation of BMM.

1.8 LANGUAGE

.1 Provide documentation in English only.

1.9 USE OF CURRENT TECHNOLOGY

.1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.

.2 Obtain Departmental Representative's approval before starting work.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 11 00 – Summary of Work

.2 Section 01 14 00 – Work Restrictions

.3 Section 01 35 00 – Special Procedures

.4 Section 01 45 00 – Quality Control

.5 Section 01 61 00 – Common Product Requirements

.6 Section 01 74 11 – Cleaning

.7 Section 01 78 00 – Close-out Submittals

.8 Section 09 91 23 – Interior Painting

.9 Section 21 05 05 – Common Work Results for Fire Suppression

.10 Section 22 05 00 – Common Work Results for Plumbing

.11 Section 23 05 00 – Common Work Results for HVAC

.12 Section 23 05 93 – Testing, Adjusting & Balancing for HVAC

.13 Section 25 05 00 – EMCS General Requirements.

1.2 REFERENCES

.1 CSA International

.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 21 - Construction/Demolition Waste Management Disposal.

.2 Submit demolition drawings:

.3 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 SITE CONDITIONS

.1 Review "Designated Substance Report" and take precautions to protect environment.

.2 If material resembling spray or trowel-applied asbestos or other designated substance [listed as hazardous] be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.

.1 Proceed only after receipt of written instructions have been received from Departmental Representative.

.2 Refer also to Section 23 05 00 – Common Work Results for HVAC.

.3 Notify Departmental Representative before disrupting building access or services.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 EXAMINATION

.1 Inspect building with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain. Refer also to Section 23 05 00 – Common Work Results for HVAC.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing services within the building where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction, and in coordination with Departmental Representative. Mark the location of these and previously capped or plugged services and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.

.2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

.3 Immediately notify Departmental Representative in case of damage to any service, designated to remain in place. Notify Departmental Representative in case of uncharted service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: requirements of authorities having jurisdiction.

.2 Protection of In-Place Conditions:

.1 Prevent movement, settlement, or damage to adjacent structures, utilities, landscaping features and parts of building to remain in place. Provide bracing and shoring required.

.2 Keep noise, dust, and inconvenience to occupants to minimum.

.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.5 Do Work in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Demolition/Removal:

.1 Remove items as indicated.

.2 Remove parts of existing building or services to permit new construction.

.3 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Note phased nature of the project. Keep work area clean, and clear of demolition articles and debris.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Refer to demolition drawings and specifications for items to be salvaged for reuse.

.4 Waste Management: separate waste materials for reuse recycling.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 03 20 00 – Concrete Reinforcing.

.3 Section 03 30 00 – Cast-in-Place Concrete.

.4 Section 03 35 00 – Concrete Finishing.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction

.2 CSA-A23.2-14, Methods of Test and Standard Practices for Concrete.

.3 CSA-O86-14, Engineering Design in Wood.

.4 CSA O121-08 (2013), Douglas Fir Plywood.

.5 CSA O151-09 (2014), Canadian Softwood Plywood.

.6 CSA O153-13, Poplar Plywood.

.7 CSA-O325-07 (R2012), Construction Sheathing.

.8 CSA O437 Series-93 (R2011), Standards on OSB and Waferboard.

.9 CSA-S269.3-M92 (R2013), Concrete Formwork.

.2 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 SUBMITTALS

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

.2 Submit shop drawings for formwork stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.

.3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.4 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, tie-hole locations, liners, and locations of temporary and permanent embedded parts. Comply with CAN/CSA-S269.3 for formwork drawings.

.5 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

.6 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

1.5 DESIGN AND CODE REQUIREMENTS

.1 Formwork shall be designed and constructed in accordance with the requirements of CSA-S269.3, and CSA A23.1, as applicable to the work.

.2 Assume full responsibility for the design and for the adequacy and safety of all formwork.

.3 The design and erection of formwork and related supporting works shall comply with construction safety legislation and regulations.

.4 Engage a Professional Engineer registered in the Province of British Columbia, fully qualified and experienced in the design of formwork and shoring, to be responsible for the design of formwork, falsework, scaffolding, shoring, and re-shoring.

Part 2 Products

2.1 MATERIALS

.1 Formwork materials:

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

.2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.

.2 Form ties:

.1 For concrete not designated 'Architectural,' use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface. Use formwork lining on inner sidewalk faces, on outer curb and sidewalk faces, and on pylon faces.

.2 Use formwork lining on housekeeping pad faces.

.3 Form release agent: non-toxic, biodegradable, low VOC.

.4 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm^2/s at 40 degrees C, flashpoint minimum 150 degrees C, open cup.

.5 Sealant: to Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 FABRICATION AND ERECTION

.1 Read drawings in conjunction with all other pertinent contract documents. Coordinate structural work with architectural, mechanical and electrical drawings for detailed dimensions, locations of openings, slopes, curbs, inserts, drainage, waterproofing and other items. Verify locations of mechanical openings, equipment, anchorage, etc. with mechanical contractor.

.2 Verify lines, levels and centres before proceeding with formwork and ensure dimensions agree with drawings.

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

.4 Align form joints and make watertight. Keep form joints to minimum.

.5 Use 20 mm chamfer strips on corners, unless specified otherwise.

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

.7 Construct forms for concrete and place ties as indicated.

.8 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.9 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete. Remove cuttings, shavings and debris from within the forms. Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the cleanout ports.

3.2 REMOVAL AND RESHORING

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

.1 7 days for slabs.

.2 Remove formwork when concrete has reached 75 % of its 28 day design strength or minimum period noted above, whichever comes later. Contractor to supply evidence of concrete strength testing before formwork is removed.

.3 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

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

3.3 CLEANING

.1 Clean forms as erection proceeds to remove foreign matter.

.2 Remove cuttings, shavings and debris from within the forms.

.3 Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through cleanout ports.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 03 10 00 - Concrete Forming and Accessories.

.3 Section 03 30 00 - Cast-in-place Concrete.

.4 Section 03 35 00 - Concrete Finishing.

1.2 REFERENCES

.1 American Concrete Institute (ACI)

.1 SP-66-04, ACI Detailing Manual 2004.

.1 ACI 315-99, Details and Detailing of Concrete Reinforcement.

.2 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A143/A143M-07 (2014), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

.2 ASTM A775/A775M-07b (2014), Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

.3 Canadian Standards Association (CSA International)

.1 CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction.

.2 CSA-A23.2-14, Methods of Test and Standard Practices for Concrete.

.3 CSA-A23.3-14, Design of Concrete Structures.

.4 CSA-G30.18-09 (R2014), Carbon-Steel Bars for Concrete Reinforcement.

.5 CSA-G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.4 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 SUBMITTALS

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

.2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and ACI 315.

.3 Submit shop drawings including placing of reinforcement and indicate:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.

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

.4 Detail lap lengths and bar development lengths to CSA-A23.3, unless otherwise indicated. Provide type B tension lap splices unless otherwise indicated.

.5 Quality Assurance: in accordance with Section 01 45 00 - Quality Control and as described in PART 2 - SOURCE QUALITY CONTROL.

.1 Mill Test Report: provide Departmental Representative, with certified copy of mill test report of reinforcing steel, minimum four (4) weeks prior to beginning reinforcing work.

.2 Submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

.6 Review of the shop drawings by the Departmental Representative is intended to assist the Contractor and does not relieve the Contractor of responsibility for the completeness and accuracy of the work and its conformance with the contract drawings and specifications.

.7 Fabrication that commences prior to shop drawing review by the Departmental Representative is at the risk of the Contractor.

.8 Shop drawings shall be sealed and signed by a qualified Professional Engineer registered or licensed in Province of British Columbia, Canada.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Store and manage hazardous materials.

.2 As a safety measure, provide bright coloured safety caps over rebar cut ends.

.3 Handle reinforcing bars with caution to prevent any damage to the existing elements.

.4 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

Part 2 Products

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Departmental Representative.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.

.3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-G30.18. 1. Deformed bars shall conform to the requirements of CSA Standard G30.18, grade 400R.

.4 Cold-drawn annealed steel wire ties: to ASTM A497/A497M.

.5 Deformed steel wire for concrete reinforcement: to ASTM A497/A497M.

.6 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

.7 Mechanical splices: Threaded-tapered rebar mechanical couplers capable of developing greater than 125% of rebar tension capacity, subject to approval of Departmental Representative.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with ACI 315 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada. Reinforcing shall be detailed in accordance with the latest edition of the ACI detailing manual or the reinforcing steel institute of Canada detailing manual.

.2 Reinforcing to be continuous unless noted.

.3 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.

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

.5 Threaded reinforcing bars to complement mechanical splice couplers to be supplied with couplers to ensure compatibility.

2.3 SOURCE QUALITY CONTROL

.1 Reinforcing work in accordance with CSA Standard CAN3-A23.1 and A23.3.

.2 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum four (4) weeks prior to beginning reinforcing work.

.3 Inform Departmental Representative of proposed source of material to be supplied.

Part 3 Execution

3.1 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.

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

.3 Replace bars which develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.

.2 Chair reinforcement not further than 1000 mm in either direction. Supply support bars, chairs, and carriers as necessary.

.3 Dowels and anchors shall be secured in position by means of templates where necessary before concrete is poured.

.4 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement. Notify the Departmental Representative at least 48 hours prior to cast of concrete to inspect the reinforcement.

.5 Ensure cover to reinforcement is maintained during concrete pour and in accordance with CSA A23.1/A23.2 according to exposure class and conditions, unless noted otherwise.

.6 Clear distances between bars, shall be not less than the nominal diameter of the bar, or 25 mm or one and one-third the maximum size of the coarse aggregate.

3.3 DESIGN LOADS

.1 Dead load: structural self-weight and existing as-is.

.2 Live load: see existing dwg. no. S-13

.3 Ground snow load: not applicable to the current scope - See existing dwg. no. S-13

.4 Wind load: not applicable to the current scope - See existing dwg. no. S-13

.5 Seismic:

.1	Sa(0.2)	=	0.93
.2	Sa(0.5)	=	0.63
.3	Sa(1.0)	=	0.32
.4	Sa(2.0)	=	0.17
.5	Ga	=	0.46
.6	Ie	=	1.0 (Normal)
.7	Mv	=	1.0 (Normal)
.8	Site class	=	d
.9	Fa	=	1.1
.10	Fv	=	1.2
.11	Rd	=	1.5
.12	Ro	=	1.3
.13	Cp	=	1.0
.14	Ar	=	2.5
.15	Ax	=	3.0
.16	Rp	=	2.5
.17	Sp	=	3.0

.6 Boiler operation weight = 11.2 kN (2500 lbs max)

.7 Other equipment load: refer to mechanical drawings for weights and locations.

3.4 CLEANING

.1 All materials shall be clean and free of all form oil or deleterious materials.

.2 All deleterious material shall be removed from the surface of the reinforcing steel in a manner acceptable to the Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 03 10 00 – Concrete Forming and Accessories.

.3 Section 03 20 00 – Concrete Reinforcing.

.4 Section 03 35 00 – Concrete Finishing.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C330/330M-14, Standard Specification for Lightweight Aggregates for Structural Concrete.

.4 ASTM C494/C494M-15a, Standard Specification for Chemical Admixtures for Concrete.

.5 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.6 ASTM D1751-04 (2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

.7 ASTM D1752-04a (2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 Canadian Standards Association (CSA International)

.1 CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction.

.2 CSA-A23.2-14, Methods of Test and Standard Practices for Concrete.

.3 CSA-A23.3-14, Design of Concrete Structures.

.4 CSA A283-06 (R2011), Qualification Code for Concrete Testing Laboratories.

.5 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.1 CSA-A3001-13, Cementitious Materials for Use in Concrete.

1.3 ACRONYMS AND TYPES

.1 Cement: Type GU or GUb - General use cement.

.2 Fly ash:

.1 Type F - with CaO content less than 8%.

1.4 DESIGN REQUIREMENTS

.1 Provide concrete and perform work to CSA Standard CAN3-A23.1.

.2 Test concrete in accordance with CSA Standard CAN3-A23.2.

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

1.5 SUBMITTALS

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

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.3 Submit testing and inspection results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.4 Concrete pours: submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.

.5 Concrete hauling time: submit for review by Departmental Representative deviations exceeding maximum allowable time of 90 minutes for concrete to be delivered to site of Work and discharged after batching.

.6 Supply pour sheets to Departmental Representative at least two days prior to concrete pour.

1.6 QUALITY CONTROL

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Submit to Departmental Representative, minimum four (4) weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.

.1 When plant does not hold valid certification, provide test data and certification by qualified independent inspection and testing laboratory that materials used in concrete mixture will meet specified requirements.

.3 Minimum four (4) weeks prior to starting concrete work, submit proposed quality control procedures for review by Departmental Representative on following items:

.1 Hot weather concrete.

.2 Cold weather concrete.

.3 Curing.

.4 Finishes.

.5 Formwork removal.

.6 Joints.

.4 Quality Control Plan: submit written report, as described in PART 3 - VERIFICATION, to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

.5 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 90 minutes after batching.

.1 Modifications to maximum time limit must be agreed to by Departmental Representative and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by Departmental Representative.

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

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Divert unused concrete materials from landfill to local facility approved by Departmental Representative.

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

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

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

Part 2 Products

2.1 MATERIALS

.1 Cement: to CAN/CSA-A3001, Type GU.

.2 Supplementary cementing materials: with minimum 25% Type F fly ash, by mass of total cementitious materials to CAN/CSA-A3001.

.3 Water: to CSA-A23.1.

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

.5 Admixtures:

.1 Air entraining admixture: to ASTM C260.

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

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

.1 Compressive strength: 25 MPa at 28 days.

.2 Net shrinkage at 28 days: maximum 5%.

.7 Sealing compound: to Section 03 35 00 Concrete Finishing.

.8 Waterstops:

.1 Waterstop shall consist of sodium bentonite and butyl rubber compound formed into uniform coils of 25mm x 20mm x 5m, with manufacturer's recommended adhesive.

.2 NSF Certified: Bentonite waterstop shall be certified by NSF International to conform to the requirements of NSF Standard 61 – Drinking Water System Components – Health Effects.

.3 Shall be stored in a dry location in the original boxes and protected from direct sunlight and rain.

.4 Waterstop shall expand by at least 300%.

.5 Waterstop shall withstand a hydrostatic pressure head of 70m.

.9 Premoulded joint fillers: Bituminous impregnated fiber board: to ASTM D1751.

.10 Weep hole tubes: plastic.

.11 Dampproofing: Emulsified asphalt, mineral colloid type, unfilled: to CAN/CGSB 37.2.

.12 Dampproofing Membrane: Heavy Duty Reinforced: two .10 mm thick polyethylene films bonded each side of asphalt treated creped kraft paper, reinforced with 13 x 13 mm fibreglass scrim. Installation as recommended by manufacturer.

.13 Insulation: as indicated.

.14 Epoxy Adhesive Anchors: injectable epoxy systems for drilled in anchorage of reinforcement into hardened concrete and into grout filled concrete block masonry. It shall be approved by ICC-ES Evaluation Services for application in cracked concrete and when subjected to wind and seismic loads.

2.2 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria in accordance with CAN/CSA-A23.1/A23.2.

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.

.2 Provide concrete mix to meet following hard state requirements:

TYPE	LOCATION	28 DAY STRENGTH f'c (MPa)	CEMENT TYPE	AGGRE G. MAX. (mm)	SLUMP (mm)	TOTAL AIR (%)	EXPOSURE CLASS
1.	New Equipment Concrete Pad	25	GU	20	80 ± 30	4-8	N

.3 Max w/c ration 0.45.

.4 Provide quality management plan to ensure verification of concrete quality to specified performance.

.5 Specified slumps are prior to the addition of any approved plasticizing admixture. When concrete is placed by pumping, the listed slumps are at discharge. Slurry or grout used in the priming of pumps is to be wasted and not used in the finished construction.

.6 All concrete shall be normal weight 2400 kg/m³ unless noted otherwise.

.7 Construction joints to be keyed and doweled as shown on the drawings or as directed by the consultant. Submit proposed details and locations of all construction joints not shown on the drawings to the Departmental Representative for approval.

.8 Levelling grout if required shall be non-shrink, non-metallic with minimum strength at three (3) days of 20 MPa and minimum 28 day strength of 50 MPa.

.9 All concrete shall be wet cured for seven (7) days minimum.

.10 Concrete pad shall be cast with a level top.

.2 Maximum fly ash content as a percentage of the total cementitious material:

.1 Concrete with exposure class N: Maximum 20% fly ash.

.3 Documentation indicating the compatibility of the water reducing admixture, the air entraining admixture, the superplasticizing admixture (if any), the silica fume (if any), and the fly ash (if any) is to be submitted upon request with the mix design for review by the Departmental Representative.

Part 3 Execution

3.1 PREPARATION

.1 Obtain Departmental Representative's approval before placing concrete. Provide 72 hours' notice prior to placing of concrete.

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

.3 During concreting operations:

.1 Development of cold joints not allowed.

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

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

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

.6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.

.7 Protect previous Work from staining.

.8 Use cold weather concreting methods in accordance with CSA-A23.1, when the mean daily temperature falls below 5°C, and use hot weather methods when the mean temperature rises above 25°C.

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

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

.11 Where new concrete is placed against existing concrete, the existing concrete surface receiving new concrete shall be intentionally roughened to a 6mm amplitude per CSA A23.3, then thoroughly cleaned, and applied with bonding agent prior to placement of new concrete.

.12 In places where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars using epoxy adhesive. The dowel free end shall be painted with asphalt and wrapped in bond-breaker.

.13 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 CONSTRUCTION

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

.2 Read drawings in conjunction with all other pertinent contract documents. Coordinate structural work with architectural, mechanical and electrical drawings for detailed dimensions, locations of openings, slopes, curbs, inserts, drainage, waterproofing and other items.

.3 Sleeves and inserts:

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

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

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

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

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

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

.7 Where indicated, set mechanical anchors with plastic forms hailed to forms and protective covers to cover future coupling end.

.4 Anchor bolts:

.1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.

.2 For epoxy anchors, drill holes, clean and fill with adhesive to manufacturers' recommendations.

.3 For expansion anchors, drill holes, clean and install anchor to manufacturers' recommendations.

.4 Protect anchor bolt holes from water accumulations, snow and ice build-ups.

.5 Drainage holes and weep holes:

.1 Form drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.

.6 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.

.7 Finishing and curing:

.1 Finish concrete in accordance with CSA-A23.1/A23.2 and Section 03 35 00 - Concrete Finishing.

.2 Use procedures as reviewed by Departmental Representative or those noted in CSA-A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.

.3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.

.4 Slabs on grade shall be wet cured for seven days minimum according to CSA-A23.1, using one of the following methods as soon as the concrete has hardened sufficiently to prevent marring:

.1 Surface covered with canvas or other satisfactory material and kept thoroughly wet.

.2 Surface sealed with polyethylene sheeting at least 6 mils thick and the concrete kept thoroughly wet.

.8 Waterstops:

.1 Install adhesive bentonite waterstops to provide continuous water seal according to manufacturer's strict instructions. Manufacturer's technical representative shall be at the site to guide the contractor during installation of their product.

.2 The installer and manufacturer's technical representative shall examine conditions of substrates and other conditions under which this section work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected and are acceptable for compliance with manufacturer's warranty requirements.

.3 Installation shall not proceed when work areas are flooded or wet to the extent that would cause bentonite waterstop to hydrate prior to concrete encapsulation.

.4 Remove dirt, debris, oil, grease, cement laitance, or other foreign matter which will impair or negatively affect the installation of the waterstop. Protect adjacent material surfaces from damage or contamination from during installation operations.

.5 Do not distort or pierce waterstop in way as to hamper performance. Press waterstop against irregular contours, filling cavities and cracks. Do not leave gaps between water bar and surface.

.6 Do not displace reinforcement when installing waterstops.

.7 Tightly butt coil ends together to form continuous waterstop

.8 Protect waterstop from water contact prior to concrete placement and product encapsulation.

.9 Replace any waterstop material that exhibit significant expansion prior to concrete encapsulation.

.9 Joint fillers:

.1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.

.2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.3 Locate and form isolation, construction, expansion joints as indicated.

.4 Install joint filler.

.5 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 1 mm of finished slab surface unless indicated otherwise.

.10 Epoxy set anchors, expansion anchors and reinforcement dowels:

.1 Install in strict accordance with manufacturer's recommendations.

.2 Minimum anchorage requirements for reinforcement dowels, Expansion Anchors and Epoxy Adhesive Anchors: as indicated.

.11 Recesses or grooves in Concrete Slab:

Formed with easily removable template blocks or equal where recesses or grooves are required in hardened concrete surfaces.

3.3 SURFACE TOLERANCE

.1 Concrete tolerance in accordance with CSA-A23.1/A23.2.

.2 See Section 03 35 00 for floor finish tolerances.

3.4 FIELD QUALITY CONTROL

.1 Site tests: conduct following test in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

.1 Concrete pours.

.2 Slump tests.

.3 Air content.

.2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative for review in accordance with CSA-A23.1/A23.2.

.1 Ensure testing laboratory is certified in accordance with CSA A283.

.3 Testing firm to take a minimum of three test cylinders for a strength test and not less than one strength test for each 40 m^3 of concrete, or portion thereof, for each type of concrete placed and not less than one test for each type of concrete placed in any one day.

.4 Testing firm to moist cure and test one cylinder in seven (7) days and to moist cure and test the remaining two cylinders in 28 days.

.5 Testing firm to take at least one slump test and one entrained air test for each set of test cylinders taken.

.6 Testing firm to take one additional test cylinder during cold weather concreting and cure on job site under same conditions as the concrete it represents.

.7 Testing firm is to report results of tests immediately to the Contractor and the Departmental Representative. The Contractor is responsible for ensuring that the concrete meets the requirements of the specifications.

.8 Testing firm is to submit to the Departmental Representative and Contractor copies of test results. Include the following information with the results:

.1 Name of the project.

.2 Date of sampling.

.3 Mix design, specified strength, slump and air content.

.4 Name of supplier, truck and ticket number.

.5 Time batched and time placed.

.6 Identification of sampling and testing technician.

.7 Cement type and admixtures used.

.8 Exact location in the structure of the concrete sampled.

.9 Ambient air and concrete temperatures.

.10 Nominal aggregate size.

.11 Water added and personnel authorizing additional water.

.12 Concrete density.

.9 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.

.10 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.11 Non-Destructive Methods for Testing Concrete: in accordance with CSA-A23.1/A23.2.

.12 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.5 VERIFICATION

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established in PART 2 - Products, by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

3.6 CONCRETE ACCESSORIES:

.1 Expansion anchors Hilti Kwik Bolt TZ or approved equivalent

.2 Adhesive anchors Hilti Hit Hy 200 or approved equivalent inserts

.3 Anchors to be installed in strict accordance with manufacturers recommendations.

.4 Minimum embedment of anchors to be 102 mm, unless otherwise specified.

3.7 DESIGN LOADS

.1 Dead load: structural self-weight and existing as-is.

.2 Live load: see existing dwg. no. S-13

.3 Ground snow load: not applicable to the current scope - See existing dwg. no. S-13

.4 Wind load: not applicable to the current scope - See existing dwg. no. S-13

.5 Seismic:

.1 Sa(0.2) = 0.93

.2 Sa(0.5) = 0.63

.3 Sa(1.0) = 0.32

.4 Sa(2.0) = 0.17

.5 Ga = 0.46

.6 Ie = 1.0 (Normal)

.7 Mv = 1.0 (Normal)

.8 Site class = d

.9 Fa = 1.1

.10 Fv = 1.2

.11 Rd = 1.5
.12 Ro = 1.3
.13 Cp = 1.0
.14 Ar = 2.5
.15 Ax = 3.0
.16 Rp = 2.5
.17 Sp = 3.0

.6 Boiler operation weight = 11.2 kN (2500 lbs max)

.7 Other equipment load : refer to mechanical drawings for weights and locations.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 03 30 00 – Cast-in-Place Concrete.

.3 Section 23 05 00 – Common Work Results for HVAC.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-25.20- 95, Surface Sealer for Floors.

.2 Canadian Standards Association (CSA)

.1 CSA-A23.1- 14, Concrete Materials and Methods of Concrete Construction.

.2 CSA-A23.2-14, Methods of Test and Standard Practices for Concrete.

1.3 QUALITY CONTROL

.1 Product quality and quality of work in accordance with Section 01 61 00 - Common Product Requirements.

.2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.

.3 Submit proof of qualifications and experience in writing to Departmental Representative.

.4 Consult with a Qualified Representative of manufacturer and shall conduct on-site pre-construction review of the correct application of products under prevailing job conditions with the representative.

1.4 PRODUCT DATA

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

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content.

.3 Include application instructions for concrete floor treatments.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Use chemical hardeners that are non-toxic, biodegradable and have zero or low VOCs.

.5 Dispose of surplus chemical and finishing materials in accordance with federal, provincial and municipal regulations.

.6 Dispose of waste from stripping of floors in a manner that will not have unfavourable effects on the environment.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Temporary lighting: Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 m² of floor being treated.

.2 Electrical power: Provide sufficient electrical power to operate equipment normally used during construction.

.3 Work area: Make the work area water tight protected against rain and detrimental weather conditions.

.4 Temperature: Maintain ambient temperature of not less than 10 degrees C from seven (7) days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

.5 Moisture: Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.

.6 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

.7 Ventilation:

.1 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

.2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.

.3 Provide continuous ventilation during and after coating application.

Part 2 Products

2.1 SEALING COMPOUNDS

.1 Surface sealer: to CAN/CGSB-25.20, Type 1 - solvent-based clear.

.2 Surface sealers may not be manufactured or formulated with formaldehyde halogenated solvents mercury lead cadmium, hexavelant chromium and their compounds.

.3 Acceptable products:

.1 Master Builders Masterseal 340, grey.

.2 Sikafloor 261^{CA},

.3 Euco Tufcoat, grey.

.4 At application rates as per manufacturer’s instruction.

2.2 CURING COMPOUNDS

.1 Moisture retention requirements to conform to ASTM C309.

.2 Select water-based, curing compounds.

.3 Acceptable products:

.1 Clear Sika Florseal W.B.

.2 Master Builders Masterkure 100W.

.3 Euco Kurez DR VOX.

2.3 MIXES

.1 Mixing, ratios and application in accordance with manufacturer's instructions.

Part 3 Execution

3.1 EXAMINATION

.1 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.

.1 Joint Sealers: to local codes and standards.

.2 Apply floor treatment in accordance with Sealer manufacturer's written instructions.

.3 Clean overspray. Clean sealant from adjacent surfaces.

.2 Verify that slab surfaces are ready to receive work and elevations and to tolerance acceptable to manufacturer.

.3 Contractor to examine all concrete slab surfaces prior to commencement of work. Any and all existing conditions that could compromise or prejudice proper execution and completion of the work shall be corrected by the Contractor prior to commencement of the work.

3.2 PREPARATION OF SLAB

.1 Remove all surface materials before application of floor treatment.

.2 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radiused edges unless otherwise indicated.

.3 Saw cut control joints where indicated to CSA-A23.1, as soon as possible, but no later than 24 hours maximum after placing of concrete.

.4 Prepare slabs to receive floor treatment in strict accordance with installation instructions.

3.3 FLOOR FINISH TOLERANCES

.1 Perform work to requirements of CAN/CSA-A23.1-09.

.2 Finish floor slab surfaces to conform to the following:

.1 Class A, with Ff = 20, Fl = 15

.3 Finished floors not meeting the specified requirements will be rejected and must be repaired by grinding, re-topping or removal and replacement at contractor's expense.

3.4 MECHANICAL FLOATING

.1 Moderately flat and conventional slabs.

.1 Mechanical float floor surfaces when bleed water has disappeared and surfaces are sufficiently hard to prevent working excess mortar to surface.

.2 Continue floating as necessary to produce surfaces of uniform texture, free from hollows, bumps and screed marks.

.3 For surfaces to be trowelled, continue floating as necessary to embed coarse aggregate particles firmly below surface mortar.

.4 Hand float in restricted areas, corners, etc.

3.5 TROWELLING

.1 Moderately flat and conventional slabs.

.1 Provide swirl-trowelled finish where floor tile is to be applied. Provide depressions to accommodate floor tile.

.2 Provide screed finish unless otherwise indicated.

.3 Trowel floor surfaces with mechanical trowelling machines fitted with steel blades.

.4 Commence trowelling when surfaces are sufficiently hard to prevent working excess fine material to surface.

.5 Perform additional trowelling at intervals so final trowelling is done just before concrete becomes so hard that further trowelling is ineffective.

.6 Finished trowelled surfaces to be hard, dense and free from blemishes and other imperfections.

.7 Hand trowel in restricted areas, corners, etc.

.8 Cure concrete as specified.

.9 Protect all hardened floors from damage during construction.

3.6 SEALING COMPOUND

.1 Apply sealing compound on all concrete floors and slabs. Concrete floors and slabs shall be water cured for a minimum of seven (7) days. Ensure slabs are sealed prior to water cure.

.2 Follow resinous floor coatings manufacturer’s instructions for sealing concrete.

.3 Follow hardener manufacturer’s instruction for sealing the hardened slabs prior to water cure.

.4 Coverage to be minimum 0.1 L/m² using short nap rollers, brushes or low pressure spray equipment.

.5 Apply after final trowelling when concrete surfaces are sufficiently hardened to prevent marring, and before surfaces start to dry.

.6 Completely remove sealing compounds from concrete slabs where required to receive other floor finishes.

3.7 PROTECTION

.1 Protect finished installation in accordance with manufacturer's instructions.

.2 Freshly placed concrete shall be protected from the effects of direct sunshine, drying winds, cold, excessive heat and running water by the use of adequate tarpaulins or other suitable material to cover completely or enclose all freshly finished surfaces until the end of the curing period specified.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Invitation to Tender, and associated documents.

.2 All sections in Division 1.

.3 All sections in Division 23.

.4 All sections in Division 25.

.5 All sections in Division 26.

1.2 SUBMITTALS

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

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals. Scanned PDF's are not acceptable. All PDF submittals must be text searchable**.**

.3 Shop drawings to show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.
- .3 Refer to individual specification sections for detailed requirements.

.4 Shop drawings and product data accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.5 Closeout Submittals:

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance manual approved by, and final copies deposited with Departmental Representative before final inspection.
- .3 Operation data to include:
  - .1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment and the integrated complete system.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.6 Site records and As-Built Drawings:

.1 Mark changes on site drawings as work progresses and as changes occur, in accordance with Section 01 78 00 – Closeout Submittals.

1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 WORK INCLUDED

.1 The objectives of the project are to:

.1 Replace boilers, primary pumps and ancillary headers and pumps in the boiler room.

.2 Provide the electrical services to the new equipment.

.3 Provide controls to the new equipment. Tie in and integrate with the existing controls and the existing control bus, front end and Operator Work Station (OWS).

.4 Maintain existing systems operational during the course of the work. Phased demolition and installation is planned to facilitate the existing systems operational.

.5 Coordinate with building maintenance staff. Minimize any shutdowns; prepare equipment and components in advance components in advance to minimize the duration of shutdowns.

.6 Where existing instrumentation, required for the controls is removed as part of the work, new instrumentation shall be re-installed in functionally comparable and adequate location, and its operation reinstated. Remit existing removed instrumentation to the Departmental Representative.

.2 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances.

.3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.

.4 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available.

.5 Be responsible for the coordination with the sub-trades, including controls and electrical work.

.6 Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, establish orderly completion and the delivery of a fully commissioned installation.

.7 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

.8 The most stringent requirements of this and other mechanical sections shall govern. Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise ordered by the Engineer in writing during the bidding period.

.9 All work shall be in accordance with the PROJECT Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.

.10 Provide seismic restraints for all required equipment, piping and ductwork.

.11 Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.

.12 "Engineer" shall mean Stantec Consulting Ltd.

1.6 ELECTRICAL AND CONTROLS WORK

.1 Be responsible for all electrical work, including power connections for the new Variable Frequency Drives (VFD-s) and re-connection to air handling units. Be responsible for the related trade permits.

.2 Hire a certified electrician, acceptable to the Departmental Representative, to perform all electrical work. Electrical work is covered under Division 26.

.3 Controls work is covered under Division 25.

1.7 SUSTAINABLE INITIATIVES

.1 The intent is to follow and comply with the general sustainable (green) initiatives.

.2 Follow instructions and initiatives such as pollution preventions and recycling of materials, packaging and debris.

.3 Use materials with low emissions and low volatile organic compounds (VOCs).

.4 For all Adhesives and Sealants provide Material Safety Data Sheets (MSDS) highlighting the materials Volatile Organic Compound (VOC) levels.

.5 Construction IAQ:

.1 During construction, meet or exceed the recommended Design Approaches of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3.

.2 Protect stored on-site or installed absorptive materials from moisture damage.

.3 During construction, all openings in supply, return and exhaust HVAC systems shall be protected from dust infiltration. Provide temporary ventilation as required.

.4 Material that emit VOCs are to be avoided, however, maintain sufficient temporary ventilation of areas where materials are being used that emit VOCs. Maintain ventilation continuously during installation, and until emissions dissipate after installation. If continuous ventilation is not possible via the building's HVAC system(s), then ventilation shall be supplied via open windows and temporary fans, sufficient to provide no less than three air changes per hour.

.5 The period after installation shall be sufficient to dissipate odours and elevated concentrations of VOCs. Where no specific periods stated in these specifications, a time period of 72 hours shall be used.

.6 Ventilate areas directly to outside; ventilation to other enclosed areas is not acceptable.

1.8 ACCEPTABLE MATERIAL

.1 Means that item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.

.2 Where two or more manufacturers are listed, the manufacturer's name shown underlined or shown with a model name and/or number was used in preparing the design. Tenders may be based on any one of those named, provided that they meet every aspect of the drawings and specifications.

.3 Where other than the underlined manufacturer or scheduled/specified manufacturer is selected or approved, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.

.4 Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.

.5 Install and test all equipment and material, in accordance with the detailed recommendations of the manufacturer.

.6 A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

1.9 ADDITION OF ACCEPTABLE MANUFACTURERS

.1 Material/products considered to satisfy the specification, but of a manufacturer other than those named in the Specifications may be submitted to the Engineer for consideration not later than five (5) working days prior to closing of tender or of bid depository subtrade tender whichever is earlier.

.2 Addition of manufacturer's names to the specifications will be by addendum only.

1.10 PERFORMANCE TESTING HOLDBACK

.1 For the EMCS Performance Testing planned after the completion of the work, a Performance Testing Holdback will be withheld from the last progress payment. The holdback will be released upon successful completion of the EMCS performance testing (refer to Section 25 01 11).

1.11 EQUIPMENT LIST

.1 Submit a completed Equipment List, showing the make of equipment and material included in the Tender, including the names of the sub-trades, 10 days after the award of the Contract.

.2 The equipment list shall be a full list of materials intended for installation.

1.12 DETAILED PRICE BREAKDOWNS

.1 10 days after the award of contract submit price breakdowns on photocopies of the Price Breakdown Forms (copies of the form can be obtained from the Engineer). Submit a separate breakdown for each section of the mechanical work listed on the Progress Claim Summary Form.

.2 In particular cases more detail may be necessary to properly assess a change order or progress claim. This additional information, which could include all suppliers and all sub-contractors, shall be supplied when requested by the Engineer.

.3 Mark-up information is required for change orders but is optional on the original tender price.

1.13 PROGRESS CLAIMS

.1 Submit with each progress claim a progress claim summary based on the Progress Claim Summary Form.

.2 Submit detailed price breakdowns on a photocopy of the Detailed Price Breakdown Form for each section of the mechanical work listed on the Progress Claim Summary Form and for each separate mechanical change order.

1.14 SCHEDULING

.1 Prepare a Construction Schedule, and be responsible for maintaining the schedule throughout the work period.

.2 Coordinate with all trades and sub-contractors and with the Departmental Representative.

.3 Incorporate within the Construction Schedule, a complete and realistic schedule, integrated with, and recognizing the reliance on, other disciplines and trades required to complete the work. Take into account the lead time for the review of operating and maintenance manuals, commissioning, verification of system operation by the Engineer and the demonstration and instruction to the Departmental Representative.

.4 Plan for the phased nature of the project, and maintain facility operational during the performance of the work. The next phase of the work shall not commence until the previous phase is complete, and the heating system confirmed operational.

.5 For each phase, provide a detailed phasing plan. Coordinate dates and activities with Departmental Representative.

1.15 RESPONSIBILITIES

.1 Visit the site before tendering. Examine all local and existing conditions on which the work is dependent. No consideration will be granted for any misunderstanding, of work to be done, resulting from failure to visit the site.

.2 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.

.3 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Engineer during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.

.4 Examine carefully the mechanical, electrical, structural and architectural drawings and confirm that the work under this Sub-Contract can be satisfactorily carried out without changes to the building as shown on these plans.

.5 Be responsible for prompt installation of this work in advance of concrete pouring or similar work. Provide and set sleeves where required.

.6 During freezing or rainy weather, protect all materials in such a manner that no harm can be done to installations already in place and/or to materials and equipment on the job.

.7 Be responsible for phasing and detailed phasing plan. Maintain interruption to the heating service to a necessary minimum. Coordinate dates and activities with Departmental Representative.

.8 On completion of the work, all tools and surplus and waste materials shall be removed and the work left in a clean and perfect condition.

1.16 COORDINATION

.1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Departmental Representative, without the Engineer's written approval.

.2 The drawings are based on the existing records information only.

.3 The drawings indicate the general location and route to be followed by the piping and ductwork. Where details are not shown on the drawings or only shown diagrammatically, the pipes and ductwork shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All ducts and pipes in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All pipes and ducts shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

.4 Work out jointly all interference problems on the site with other trades and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference drawings, showing exact locations of mechanical equipment within service areas, shafts and the ceiling space. Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required.

Advise the Engineer of space problems before fabricating, or installing any material or equipment. Demonstrate to the Engineer on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required. Remove and replace improperly installed equipment to satisfaction of the Engineer at no extra cost. Extras for improper coordination and removal of equipment to permit remedial work shall not be allowed.

.5 Plan for the phased nature of the project, and maintain facility operational during the performance of the work. The next phase of the work shall not commence until the previous phase is complete, and the heating system confirmed operational. Coordinate activities to minimize interruption to services. Coordinate plans, dates and activities with Departmental Representative.

.6 When open web structural joists are used, verify on site to ensure adequate space is available for installation of pipes.

1.17 HOISTS AND SCAFFOLDS

.1 Provide all necessary interior movable or roller scaffolds, platforms, lifts and ladders for the installation of the work.

1.18 REVIEW OF WORK

.1 The Engineer representative shall review all work prior to it being concealed.

.2 All work shall be approved by all authorities having jurisdiction.

.3 All openings shall be sealed appropriately in particular in fire rated walls and floors (all walls and floors of the boiler room). Sealing shall be inspected prior to covering.

1.19 PERMITS

.1 Obtain all required permits and pay all fees therefore and comply with all Provincial, Municipal and other legal regulations and bylaws applicable to the work.

.2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.20 CODES, REGULATIONS AND STANDARDS

.1 Work shall conform to the following codes, regulations and standards, and all other codes and trade regulations in effect at the time of award of Contract, as well as any others having jurisdiction. The latest revision of each code and standard shall apply unless otherwise specified in the contract documents:

.1 Canadian Standards Association:

.1 CSA Standard C22.1, Canadian Electrical Code.

.2 CSA Standard B51-14, Boiler, Pressure Vessel and Pressure Piping Code.

.1 Canadian Gas Association:

.1 National Standard of Canada CSA-B149.1-10 - Natural Gas & Propane Installation Code.

.2 Province of British Columbia:

.1 B.C. Safety Authority Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation.

.2 B.C. Building Code 2010.

.3 B.C. Amendment to Canadian Electrical Code.

.4 B.C. Electrical Safety Branch Bulletins.

.5 B.C. Code Amendments, Gas Safety Act & Regulations.

.6 WorkSafeBC: Guidelines for Workers Compensation Act and Occupational Health and Safety (OHS) Regulation.

.7 B.C. Fire Code 2010.

.3 SMACNA Publications:

.1 Guidelines for seismic restraints of mechanical systems.

.2 Where these specifications specifically indicate requirements more onerous than the aforementioned codes, these specifically indicated requirements shall be incorporated into the work.

1.21 WARRANTY

.1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.

.2 Take note of any extended warranties specified.

.3 Refer to Section 23 09 00 for Control System warranty requirements.

.4 Furnish a written warranty stating that all work executed will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance, which shall include one (1) complete summer and one (1) complete winter of uninterrupted operation. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.

.5 The above parties further agree that they will at their own expense promptly investigate any mechanical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the guaranty-warranty.

1.22 ENERGY CONSUMPTION

.1 Engineer may reject equipment submitted for approval or review on basis of performance or energy consumed or demanded.

1.23 ASBESTOS

.1 All material / products installed shall be free of asbestos.

1.24 ASBESTOS REMOVAL

.1 Assessment of asbestos in the facility was conducted; a designated substance report is available. Obtain the report from the Departmental Representative, and avoid disturbing components suspected to contain asbestos. When working in areas suspected to contain the substance, seal it in place to avoid disturbance.

Some asbestos is known to be present in the joint sealing mastic compound around ducts. Avoid disturbing duct joints, or adjacent areas.

.2 If the Contractor, during renovations / demolition, should discover asbestos (or material suspected to be asbestos) on piping, ductwork, etc., he shall immediately cease all work in that area and advise the General Contractor. The General Contractor shall take immediate appropriate action to verify presence of friable asbestos and be responsible for the removal of all friable asbestos.

.3 The Contractor will not be entitled to a claim for any delays resulting from the investigation of or removal of asbestos.

1.25 WORKMANSHIP

.1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Engineer and the Trade.

.2 The Engineer shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.

.3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Engineer.

1.26 PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

.1 Installed mechanical equipment whose performance is questioned by the Engineer, may be subject to performance verification as specified herein.

.2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.

.3 The Engineer will determine by whom testing shall be carried out. When requested, the contractor shall arrange for services of an independent testing agency.

.4 Testing procedures shall be reviewed by the Engineer.

.5 Maintain building comfort conditions when equipment is removed from service for testing purposes.

.6 Promptly provide the Engineer with all test reports.

.7 Should test results reveal that originally installed equipment meets specified performance requirements, Departmental Representative will pay all costs resulting from performance verification procedure.

.8 Should test results reveal that equipment does not meet specified performance requirements, equipment will be rejected and the following shall apply:

.1 Remove rejected equipment. Replace with equipment, which meets requirements of Contract Documents including specified performance requirements.

.2 Replacement equipment will be subject to performance verification as well; using the same testing procedures on originally installed equipment.

.3 Contractor shall pay all costs resulting from performance verification procedure.

1.27 PHASED CONSTRUCTION

.1 Existing systems can only be shut down one at a time. Make all allowances to phase the work in accordance with the project phasing.

.2 All existing services and the existing building(s) must be maintained in operation. Provide and install temporary services as required.

.3 All trades shall make allowance for the implications of having to totally complete all work on one system before proceeding with work in the next system or the next pod / building.

1.28 SEQUENCE OF WORK

.1 Before interrupting major services notify the Departmental Representative well in advance and arrange an acceptable schedule for the interruptions.

.2 Before interrupting any services complete all preparatory work as far as reasonably possible and have all necessary materials on site and prefabricated (where practical) and work continuously to keep the length of interruption to a minimum.

.3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when connecting into the existing systems.

1.29 BUILDING OPERATION DURING CONSTRUCTION

.1 In order to minimize operational difficulties for the building staff and occupants, the various trades must cooperate with the Departmental Representative throughout the entire construction period and particularly ensure that noise is minimized.

.2 Convenient access for the staff and public to the building must be maintained at all times. Minor inconvenience and interruption of services will be tolerated, provided advance notice is given and coordinated. The Contractor will be expected to coordinate his work, in consultation with the Departmental Representative, so the operation of the facility can be maintained as nearly normal as possible.

1.30 EXISTING SERVICES

.1 Protect all existing services encountered. Every effort has been made to show the known existing services. However, the removal of concealing surfaces may reveal other existing services. Work with the Departmental Representative's staff to trace the originating source and points served. Obtain instructions from the Engineer when existing services require relocation or modifications, other than those already indicated in the Contract Documents.

.2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative's approval of the timing, and work to minimize any interruptions.

.3 Shutdowns, to permit connections, will be carried out by maintenance staff.

1.31 SALVAGE

.1 All piping, ducting and equipment, which becomes redundant and is no longer required due to the work in this Contract, shall be completely removed.

.2 All existing items which need to be removed, and which have a reasonable salvage value, such as fans and motors, air terminals, plumbing fixtures, and valves, shall be carefully removed and handed over to the Departmental Representative. Handing over to the Departmental Representative includes moving to Departmental Representative's designated storage place on site. These items shall not become the property of the Contractor. Obtain a written receipt from the Departmental Representative detailing each of the items handed over.

.3 Remove all redundant material, not required by the Departmental Representative, from the site.

1.32 REUSED EQUIPMENT

.1 Where existing equipment is being relocated and re-used, check and report on the condition to the Engineer before reinstallation.

1.33 DEMOLITION

.1 Existing Services:

.1 Disconnect and cap all mechanical services in accordance with requirements of local authority having jurisdiction.

.2 Maintain all building services as required during demolition/removal of existing.

.2 Demolition:

.1 Carry out demolition in a manner to cause as little inconvenience to the adjacent occupied building area as possible. Coordinate the activity with the Departmental Representative.

.2 Carry out demolition in an orderly and careful manner.

.3 All removal of existing equipment, pipes and ductwork that may affect occupied areas of the building to be done as scheduled with the Departmental Representative.

1.34 PROJECT CLOSE-OUT REQUIREMENTS

.1 Refer to detailed specifications in each section for further, detailed requirements.

.2 All life safety systems must be operational and tested and demonstrated to Engineer prior to issuance of Schedule C.

.1 Controls:

.1 Controls system completion report (check sheets).

.2 Controls system final electrical approval certificate.

.3 Control system sequences confirmed and set-points verified and documented.

.4 As built control drawings.

.5 Control training signed off by Departmental Representative (Indicate dates of training in letter and attendance).

.6 List of control manuals and documents turned over.

.7 Printed copy of control program and database. Printed to disk in word format acceptable.

.8 Disc of control system database.

.9 Calibration report for refrigeration, carbon monoxide and CO sensors.

.10 Airflow station start up and calibration report.

.2 Mechanical:

.1 Flushing and cleaning of piping report.

.2 Chemical Treatment Report.

.3 Startup Reports (Boilers, Pumps and VFD-s).

.4 Boiler and Pressure Vessel Safety Inspection Certificate.

.5 Boiler Inspection Branch certificate.

.6 Gas fired appliances/gas line/pressure piping certificate.

.7 Registration certificates for all pressure vessels.

.8 Pressure test reports for heating piping system.

.9 Seismic inspection report, and letter of assurance from Seismic Engineer.

.10 Valve tag chart.

.11 As built drawings.

.12 Equipment Warranty and Extended Warranty Certificates.

.13 List of spare parts signed off by Departmental Representative.

.14 O&M Manuals.

.15 Fire stop letter of assurance.

.3 Electrical:

.1 Final electrical approval certificate.

.4 Miscellaneous:

.1 Identification Schedules.

.2 Demonstrations to Departmental Representative signed off by Departmental Representative.

.3 List of incomplete or deficient work prepared by each sub trade.

.4 Contractor's Letter of Guarantee.

.5 Signed-off substantial completion inspection report.

.6 List of spare parts signed off by Departmental Representative.

1.35 SUBSTANTIAL PERFORMANCE REQUIREMENTS

.1 Before the Engineer is requested to make an inspection for substantial performance of the work:

.1 Commission all systems and prove out all components, interlocks and safety devices.

.2 Submit a letter certifying that all work (including calibration of instruments and balancing of systems) is complete, operational, clean and all required submissions have been completed.

.3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Engineer, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.

.2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:

.1 All reported deficiencies have been corrected.

.2 Testing and balancing completed.

.3 Final electrical approval certificate submitted.

.4 Operating and Maintenance Manuals completed.

.5 "As Built" Record Drawing ready for review.

.6 System Commissioning has been completed and has been verified by Engineer.

.7 All demonstrations to the Departmental Representative have been completed.

.3 Letters of assurance will not be issued until the following requirements have been met:

.1 All items listed in .1 and .2 above have been completed.

.2 Certificate of Penetrations through separations.

.3 Electrical Inspection - Certificate of inspection.

.4 Gas Inspection - Certificate of inspection (as applicable).

.5 Seismic Engineers letter of Assurance and final inspection report.

.6 Certificate of Substantial Performance.

1.36 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

.1 Work which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.

.2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of the Work have been met and verified.

Part 2 Products

2.1 DUCT AND PIPE MOUNTED CONTROL AND SENSING EQUIPMENT

.1 The following automatic control equipment will be supplied by Division 25 (Controls) but installed by the appropriate trade sections of the Division 23 Mechanical:

.1 Automatic control valves.

.2 Temperature control wells.

.3 Pressure tappings.

.4 Flow switches.

.5 Static pressure sensors.

2.2 ACCESS DOORS

.1 Supply flush mounted access doors, for installation by Building Trades in furred ceilings and walls, to permit servicing of mechanical equipment and accessories, inspection of life safety or operating devices, and where specifically indicated.

.2 Unless otherwise noted, access doors shall be minimum: 450 mm x 450 mm for body entry; 300mm x 300mm for hand entry; 200 mm x 200 mm for cleanout access. Access doors in building surfaces shall be at least as large as duct access panels accessed through them and shall be oversized when necessary. Size to suit masonry modules when located in a masonry wall.

.3 Locate access doors so that all concealed items are readily accessible for adjustment, operation and maintenance. Locate in service and storage areas wherever possible. Do not locate in panelled, feature or special finish walls, without prior approval of the Departmental Representative.

.1 Access doors in fire separations of 3/4 hour rating, and higher, and firewalls shall have a compatible fire rating and a ULC label with tamper-proof latch, self closing.

.4 Minimum Requirements:

.1 180 degree door swing, mitred rounded safety corners flush welded, concealed hinges, screwdriver latches, and anchor straps or lugs to suit construction, all steel prime coated.

.2 Plaster or wet wall construction: 14 gauge bonderized steel flush with wall or ceiling type with concealed flange.

.3 Masonry or drywall construction: 16 gauge for 400 mm x 400 mm and smaller, 14 gauge for 450 mm x 450 mm and larger bonderized steel face of wall type with exposed flange.

.4 Tile, ceramic tile, marble, terrazzo, plaster or wet wall construction in washrooms and other special areas: 14 gauge stainless steel flush with wall or ceiling type with concealed flange.

.5 Acoustical tile ceiling and similar block materials: 14 gauge bonderized steel recessed ceiling type.

.6 Access panels in fire separations and fire walls shall have a compatible fire rating and ULC label.

2.3 OPERATING AND MAINTENANCE MANUALS

.1 Provide operation and maintenance data for incorporation into manual. Manuals to be prepared by an approved independent contractor specializing in operating and maintenance manuals.

.2 Definition: detailed information and records of individual products provided by manufacturer or supplier as part of project requirements, and of systems, describing operation and maintenance of each item.

.3 Operating data to include:

.1 Environmental and other control schematics for each system.

.2 Description of each system and its controls.

.3 Description of operation of each system at various loads together with reset schedules and seasonal variances.

.4 Operating instruction for each system and each component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data shall include:

.1 Servicing, maintenance, operating and trouble-shooting instructions for each item of equipment.

.2 Equipment manufacturer's performance data sheets.

.3 Equipment performance verification test results.

.5 Approvals:

.1 Submit two drafts of Operating and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless so directed by Engineer.

.2 Make any changes in submission as may be required and re-submit as directed.

2.4 RECORD DRAWINGS

.1 Site records:

.1 Engineer will provide one set of mechanical drawings (white prints). Mark thereon all changes as work progresses and as changes occur.

.2 On a weekly basis, transfer information to white prints revising white prints to show all work as actually installed.

.3 Make these drawings available for reference purposes and to inspection at all times. The marked-up set of prints shall be reviewed on site monthly by the Engineer during the construction process. This review will form a requirement for approval of the monthly progress claim.

.2 As-built drawings:

.1 Prior to start of testing, balancing and adjusting, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS" (This drawing has been revised to show mechanical systems as installed) (Signature of Contractor) (date).

.3 Submit to Engineer for approval and make all corrections as directed.

.4 Testing, balancing and adjusting to be performed using as-built drawings.

.5 Hand over completed white prints as-built drawings with Operating and Maintenance Manuals.

.3 CAD Drafting:

.1 Obtain the services of the Engineer to transfer all changes to amend the CAD files in the latest version of AutoCAD. Allow a single per project cost of $600.00 for all CAD drafting.

Part 3 Execution

3.1 EXISTING SERVICES

.1 Protect all existing services encountered. Obtain instructions from Departmental Representative when existing services require relocation or modifications, other than those already indicated in the Contract Documents.

.2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative's approval of the timing, and work to minimize any interruptions.

.3 Shutdowns, to permit connections, will be carried out in cooperation with the maintenance staff.

.4 In order to maintain existing services in operation, provide temporary relocations and/or bypasses of piping as required.

.5 Be responsible for any damages to existing systems by this work.

3.2 CUTTING, PATCHING, DIGGING, CANNING AND CORING

.1 Include all cutting, patching, digging and canning required to accommodate the mechanical services.

.2 Openings through structural members of the building shall not be made without the approval of the Consultant.

.3 Allow oversized openings for pipe penetrations where insulation is specified.

.4 Contractor shall be on site and coordinate sleeves and block out requirements in accordance with the project construction schedule to minimize coring.

.5 Verify locations required for coring.

3.3 EQUIPMENT SUPPORTS

.1 Provide stands and supports for equipment and materials supplied.

.2 Lay out concrete bases and curbs required under Division 23. Coordinate with Division 3. All concrete work is under Division 3.

.3 Concrete bases shall be a minimum of 100 mm thick, or as noted and shall project at least 150 mm outside the bedplate, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.

.4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25 mm above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout.

.5 Construct equipment supports of structural steel or steel pipe. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.

.6 Support ceiling hung equipment with rod hangers and/or structural steel.

3.4 EQUIPMENT RESTRAINT

.1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

.2 Refer to Section 23 05 49.01 - Seismic Restraint Systems.

3.5 EQUIPMENT INSTALLATION

.1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.

.2 Provide means of access for servicing equipment including permanently lubricated bearings.

.3 Pipe equipment drains to floor drains.

.4 Line up equipment, rectangular cleanouts and similar items with building walls wherever possible.

3.6 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation by other divisions.

3.7 MISCELLANEOUS METALS

.1 Be responsible for all miscellaneous steel work relative to Division 23 of the Specifications, including but not limited to:

.1 Support of equipment.

.2 Hanging, support, anchoring, guiding and relative work as it applies to piping, ductwork, heat exchangers, hot water storage tanks, expansion tanks, fans and mechanical equipment.

.3 Earthquake restraint devices - refer to Section 23 05 49.01 - Seismic Restraint Systems.

.4 Pipe anchor and/or support posts.

.2 All steel work shall be primed and undercoat painted and finish painted with two coats of air dry enamel paint.

3.8 FLASHING

.1 Flash and counterflash where mechanical equipment passes through weather or water proofed walls, floors, and roofs.

.2 Flash, vent and soil pipes projecting 75 mm minimum above finished roof surface with lead worked 25 mm minimum into hub, 300 mm minimum clear on side with minimum 600 x 600 mm sheet size. For pipes through outside walls turn flange back into wall and caulk.

.3 Provide curbs for mechanical roof installations 200 mm minimum high above roof insulation. Flash and counterflash with galvanized steel, soldered and made waterproofed.

3.9 DIELECTRIC COUPLINGS

.1 Provide dielectric couplings wherever pipes of dissimilar metals are joined.

.2 Provide insulating unions for pipe sizes NPS 2 and under and flanges for pipe sizes over NPS 2.

.3 Provide felt or rubber gaskets to prevent dissimilar metals contact.

3.10 LUBRICATION OF EQUIPMENT

.1 Lubricate all new equipment prior to being operated, except sealed bearings, which shall be checked.

.2 Use the lubricant recommended by the manufacturer for the service for which the equipment is specified.

.3 Extend lubricating connections and sight glasses to the outside of housings, where lubricating positions are not readily accessible.

3.11 PAINTING

.1 Painting of all equipment and materials, supplied under Division 23 and 25, installed in mechanical equipment areas and inside finished areas of the building or exposed outside the building.

.2 Clean exposed bare metal surfaces supplied under Divisions 23 removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal. Finish paint with two coats of air dry enamel paint.

.3 Repaint all marred factory finished equipment supplied under Division 23, which is not scheduled to be repainted, to match the original factory finish.

.4 Natural gas and fire protection piping shall be painted for identification purposes over their entire lengths throughout all indoor and outdoor exposed areas:

.1 Gas: Yellow.

.2 Fire: Red.

3.12 EQUIPMENT PROTECTION AND CLEAN UP

.1 Protect equipment and material in storage, on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 All mechanical equipment stored on site shall be kept in a dry, heated and ventilated storage area.

.3 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign material.

.4 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.5 Provide, install and maintain 30% efficient (MERV 8) temporary filters to return and exhaust air openings from ceiling spaces to prevent air born dust from entering ducts, plenums and coils. Install filters to return air grilles when fans are operated and building is not at a clean condition.

3.13 DECONSTRUCTION

.1 Includes all labor, materials, equipment and services necessary and incidental to complete all the deconstruction and removal of all related mechanical installations as identified on the Drawings.

.2 The Contractor shall be responsible for deconstruction and removal of all existing mechanical equipment and systems where shown for deconstruction.

.3 Contractor shall verify the extent of the deconstruction work. Any questions as to which systems are to be removed versus which systems are to remain shall be referred to Departmental Representative for clarification prior to commencing deconstruction work.

.4 The deconstruction work shall be a phased operation and shall comply with the construction sequence schedule. The Contractor shall submit a schedule of deconstruction work 14 days prior to commencement of work. The Contractor shall not proceed with the work until receiving written approval from Departmental Representative.

.5 The Contractor shall be responsible for coordinating deconstruction of all affected mechanical equipment and systems to prevent disruption to the facility and minimize downtime.

.6 The Contractor shall be responsible for coordinating deconstruction by other Divisions of the Specifications to prevent disruption to the facility and to minimize downtime.

.7 The Contractor shall include all temporary connections necessary to permit the Departmental Representative or users to occupy areas of the building during the various construction phases.

.8 Contractor shall remove existing equipment and systems, shown or specified, necessary or reasonably inferred, for completion of work. All deconstruction waste and materials removed will become the property of the Contractor, removed from the premises and legally disposed off-site.

.9 Contractor shall remove refrigerant from cooling equipment and dispose of in accordance with all Base and Federal regulations.

.10 Existing work altered during the course of construction shall be placed in safe operating condition and shall be maintained and remain in service, unless otherwise noted, and shall be restored to satisfactory operating condition.

.11 Where existing piping is removed, cap piping and pressure test to make tight.

.12 After completing deconstruction work inspect all exposed finishes and repair damaged finishes. Reinstall fire stopping at rated penetrations, where applicable.

3.14 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.15 DEMONSTRATION

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Departmental Representative may record these demonstrations for future reference.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and requirements for installation of mechanical piping.

.2 This applies to piping in Divisions 21, 22, 23 and 25.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 CAN4-S115-M85, Standard Method of Fire Tests of Firestop Systems.

.2 American Society for Testing and Materials International, (ASTM):

.1 ASTM E814 - 11a, Standard Test Method for Fire Tests of Penetration Firestop Systems.

.3 National Fire Code of Canada (NFCC 2010).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 - Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet.

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets for each piping system to include the following information:

.1 Pipe sleeves through rated and non-rated separations.

.2 Installation of escutcheons, where required.

.3 Pipe support type and spacing.

.4 Details of pipe attachment to structure.

.5 Pipe cleanouts where shown and specified.

.6 Access to valves, cleanouts, etc.

.7 Pipe slope where specified.

.8 Pipe insulation (where applicable and specified).

.9 Pressure and leak testing report.

.10 Comments on seismic installation.

.11 Maintenance instructions.

.12 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly for all equipment.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment and components.

.3 Coordinate space for disassembly and maintenance especially with regards to cleaning of the boilers; review shop drawings and manufacturer’s recommendations and coordinate prior to installation (once boilers are physically on site) to ensure proper installation from the perspective of access and ease of maintenance.

3.4 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

.1 Install manual air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

.1 General: Compatible with system, to suit pressure rating of system.

.2 Locations: Where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: Isolating flanges.

3.7 PIPEWORK INSTALLATION

.1 Comply with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.2 Screwed fittings jointed with Teflon tape, unless stated otherwise.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.5 Assemble piping using fittings manufactured to ANSI standards.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space. In industrial work and shop areas, piping will generally be surface mounted.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion where required and as indicated.

.14 Valves:

- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.
- .3 Install with stems above horizontal position unless otherwise indicated.
- .4 Valves accessible for maintenance without removing adjacent piping.
- .5 Use ball valves at branch take-offs for isolating purposes except where otherwise specified.

.15 Check Valves:

- .1 Install silent check valves on discharge of pumps and elsewhere as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.8 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

.1 All piping, tubing, ducts, wiring, conduits, etc., passing through rated fire separations shall be smoke and fire proofed with ULC approved materials in accordance with CAN4-S115-M85 and ASTM E814 standards and which meet the requirements of the Building code in effect. This includes new services, which pass through existing rated separations, and also all existing services, which pass through a new rated separation or existing separations whose rating has been upgraded.

.2 Fire stopping is included in Section 07 84 00 – Fire Stopping.

3.9 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

.1 All piping, tubing, ducts, wiring, conduits, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent the passage of smoke and/or transmission of sound. Refer to "pipe sleeve" clause in this section for packing and sealing of pipe sleeves.

3.10 PIPE SLEEVES

.1 Provide pipe sleeves for all piping passing through rated walls and floors. Sleeves to be concentric with pipe.

.2 Pipes and ducts passing through fire rated separations that have no fire resistance (non-rated separations) do not require a sleeve, but the insulation at the separation should be wrapped with 0.61mm thick galvanized sheet steel band to which to apply the flexible caulking compound to.

.3 Pipe sleeves for floors and interior walls shall be minimum 0.61mm thick galvanized sheet steel with lock seam joints.

.4 Pipe sleeves for perimeter walls and foundation walls shall be cast iron sleeve or Schedule 40 steel pipe with annular fin continuously welded at midpoint and protruding 150 mm beyond sleeve diameter. Annular fin shall be embedded into centre of wall.

.5 Pipe sleeves for wet or washdown floor areas shall be Schedule 40 steel pipe, unless indicated otherwise.

.6 Except as otherwise noted pipe sleeves are not required for holes formed or cored in interior concrete walls or floors.

.7 Pipe sleeves shall extend 50 mm above floors in unfinished areas and wet areas and 6 mm above floors in finished areas, unless indicated otherwise.

.8 Pipe sleeves shall extend 25 mm on each side of walls in unfinished areas and 6 mm in finished areas.

.9 Pipe sleeves shall extend 25 mm beyond exterior face of building. Caulk with flexible caulking compound.

.10 Sleeve Size: 12 mm clearance all around, between sleeve and pipe or between sleeve and pipe insulation.

.11 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.

.12 Packing of Sleeves:

.1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and pipe or between sleeve and pipe insulation shall be caulked with waterproof fire retardant non-hardening mastic.

.2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.11 ESCUTCHEONS AND SLEEVES

.1 Provide on pipes passing through finished walls, partitions, floors and ceilings.

.2 Plates shall be stamped steel, split type, chrome plated, or stainless steel, concealed hinge, complete with springs, suitable for external dimensions of piping/insulation. Secure to pipe or finished surface. For all pipes passing through suspended ceilings and uninsulated piping passing through walls. Outside diameter shall cover opening or sleeve.

.3 Where pipe sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.

.4 Do not install escutcheons and plates in concealed locations.

3.12 PREPARATION FOR FIRESTOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Fire Stopping.

.2 Uninsulated unheated pipes not subject to movement: No special preparation.

.3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.

.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.13 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 – Cleaning, supplemented as specified in relevant mechanical sections.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.14 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: Test as specified in relevant sections of Divisions 22 and 23.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Divisions 22 and 23.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Departmental Representative.

.6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.15 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Departmental Representative.

.2 Request written approval by Departmental Representative 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

3.16 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Electrical motors, drives and guards for mechanical equipment and systems.

.2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Divisions 21, 22, 23 and 25. Refer to Division 26 for quality of materials and workmanship.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC).

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

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

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

.2 Shop Drawings:

.1 Submit shop drawings for review. Include the following:

.1 Manufacturer's printed product literature, specifications and datasheets.

.2 Motor characteristics, performance criteria, and limitations.

.3 Installation requirements.

.4 Efficiencies.

.5 Compatibility with variable speed drive, where scheduled.

.6 Motor shop drawings will usually be submitted with the equipment which the motor serves.

.3 Quality Control Check Sheets.

.4 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA and applicable Province of BC regulations.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 - Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet.

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Equipment number.

.2 Sheave and belt size.

.3 Make and model number.

.4 Belt guard installed?

.5 Access for lubrication without removing belt guard?

.6 Motor efficiency.

.7 Compatibility with variable speed drive, where scheduled.

.8 Installation.

.9 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Separate waste materials for re-use and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Motors: high efficiency, in accordance with BC Hydro standards and to ASHRAE 90.1.

2.2 MOTORS - GENERAL

.1 Provide motors for mechanical equipment as specified.

.2 Unless noted otherwise, provide open drip-proof, ball or roller bearing motors with grease fittings.

.3 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.4 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 575 V, unless otherwise indicated.

.5 All motors shall be designed and manufactured to operate with ±10% voltage and ±5% frequency variations of the nameplate ratings. Combined voltage and frequency variation shall not exceed ±10%.

.6 Motors will be rated for a 1.15 service factor in a 40°C ambient environment.

.7 All motors to be standard 1800 RPM unless specifically scheduled otherwise.

.8 Provide all motors with terminal boxes, suitable for power connections.

.9 Provide screw adjustable bases on all belt-connected motors.

.10 Motors to be of the capacitor start type when they may be manually cycled from a starting switch, which is located in the finished space.

.11 Motors exposed to outdoor temperature to be lubricated with lubricants suitable for operation at 6 deg. C. below the lowest temperature recorded by ASHRAE or the Climatic Information (Supplement to the National Building Code), for the location in which they are installed.

2.3 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

2.4 ELECTRIC MOTORS – PREMIUM EFFICIENCY

.1 All motors shall be provided with premium efficiency classification with non-wicking leads, class 'B' for O.D.P. motors (pumps only) and class 'F' for TEFC motors insulation (minimum).

.1 Premium efficiency open drip-proof motors shall have the following typical full load efficiencies (nominal):

HP	Premium Efficient - Minimum Efficiency (%)		
	3600 RPM 2 Pole	1800 RPM 4 Pole	1200 RPM 6 Pole
1	80.0	85.5	82.5
1.5	84.0	86.5	86.5
2	85.5	86.5	87.5
3	86.5	89.5	88.5
5	91.0	89.5	90.2
7.5	88.5	91.0	92.4
10	90.2	91.7	91.7
15	91.0	93.0	92.4

.2 Premium efficiency totally enclosed fan cooled motors shall have the following typical full load efficiencies (nominal).

HP	Premium Efficiency - Minimum Efficiency (%)		
	3600 RPM 2 Pole	1800 RPM 4 Pole	1200 RPM 6 Pole
1	N/A	86.5	81.5
1.5	85.5	85.5	86.5
2	85.5	85.5	87.5
3	87.5	88.5	88.5
5	89.5	89.5	89.5
7.5	91.0	91.7	91.7
10	91.7	91.7	91.7
15	91.7	92.4	91.7

.2 Acceptable Manufacturers - premium efficient motors: Hyundai Crown Triton Series Inverter Shield, TEFC, Premium Efficiency; Marathon Electric XRI Series, ODP, Premium Efficiency; Baldor Super-E, Premium Efficiency.

Part 3 Execution

3.1 ELECTRIC MOTORS

.1 Unless otherwise noted, starters and protection devices will be included under the Electrical Division of the Specification.

.2 Assist Division 26 to ensure proper connection, correct thermal overload protection and correct motor controls.

.3 Where starters are included in this Division as an integral part of packaged equipment, they shall contain thermal overload protection in all ungrounded lines.

.4 Equipment, which has more than one voltage rating, shall be fed from a single power source through a disconnect switch.

.5 If delivery of specified motor will delay delivery or installation of any equipment, install an acceptable motor for temporary use. Final acceptance of equipment will not be given until specified motor is installed.

.6 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.3 SETTING AND ALIGNMENT

.1 Employ a journeyman millwright to align all V-belt drives and/or shaft coupling drives prior to initial start up. The millwright shall also check that centrifugal fan wheels are properly centred on fan shafts.

.2 For pumps, align shaft couplings, using a dial indicator, to within +/-0.051 mm after grouting is complete and the piping system is operational.

.3 Align V-belt drives using a straight edge.

.4 Submit a certificate from the millwright employed, certifying that all shaft couplings and V-belt drives have been aligned and centrifugal fan wheels centred prior to initial start up and checked again after final system balance adjustment.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Minimum requirements for welding mechanical systems.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 05 - Installation of Pipework.

1.3 REGULATORY REQUIREMENTS

.1 All components, products and fabrication techniques shall be provided in compliance with the Regulations and Requirements of the Province of British Columbia "Power Engineers Boilers and Pressure Vessel Safety Act and Regulations".

.2 Installation of, and repair or alterations to, pressure piping systems shall be performed only by licensed Contractors and licensed Welders, certified for the work being done in accordance with the Regulations and Requirements of the Province of British Columbia "Power Engineers Boilers and Pressure Vessel Safety Act and Regulations".

.3 Field welding to be in accordance with the procedures of CSA-W55.2 and CSA-W117.2 and the current edition of ASME/ANSI B31.1 and B31.9 Code.

1.4 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):

- .1 ANSI/ASME B31.1-2012, Power Piping.
- .2 ANSI/ASME B31.3-2012, Process Piping.
- .3 ANSI/ASME B31.9-2011, Building Services Piping.
- .4 ANSI/ASME Boiler and Pressure Vessel Code-1998:
  - .1 Section I: Power Boilers.
  - .2 Section V: Nondestructive Examination.
  - .3 Section IX: Welding and Brazing Qualifications.

.2 American Welding Society (AWS):

- .1 AWS C1.1-2012, Recommended Practices for Resistance Welding.
- .2 AWS Z49.1-2012, Safety Welding, Cutting and Allied Process.
- .3 AWS W1-2000, Welding Inspection Handbook.

.3 Canadian General Standards Board (CGSB):

- .1 CAN/CGSB-48.2-92, Spot Radiography of Welded Butt Joints in Ferrous Materials.

.4 Canadian Standards Association (CSA International):

.1 CSA W48 series-06, Filler Metals and Allied Materials for Metal Arc Welding.

.2 CSA B51-09, Boiler, Pressure Vessel and Pressure Piping Code.

.3 CSA-W117.2-12, Safety in Welding, Cutting and Allied Processes.

1.5 QUALIFICATIONS

.1 Welding qualifications in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Furnish welder's qualifications to Departmental Representative.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Welders:

.1 Welding qualifications in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Submit welder's qualifications to Departmental Representative.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors:

.1 Inspectors qualified to CSA W178.2.

.3 Certifications:

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.7 SUBMITTALS

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

.2 Welder’s qualifications.

.3 Quality Control Check Sheets.

.4 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.8 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 – Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Provide list of names of all personnel who will be welding the project.

.2 Provide copies of welder's qualifications.

.3 Quality Control Check Sheet.

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Pipe system type – water, steam, natural gas, etc.

.2 Description of welding procedure for each system.

.3 Copy of American Welding Society AWS W1, Welding Inspection Requirements.

.4 List of any welds replaced after finding defects.

.5 Hydrostatic test results.

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Refer to Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 QUALITY OF WORK

.1 Welding: in accordance with ANSI/ASME B31.1, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and any special procedures specified elsewhere in Division 23.

3.3 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.

.3 Do not conceal welds until they have been inspected, tested and approved by Departmental Representative.

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook.

3.5 SPECIALIST EXAMINATIONS AND WELDING TESTS

.1 General:

.1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Departmental Representative.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V and CSA B51.

.3 Inspect and test 5 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as

"particle") tests and spot full gamma ray radiographic (hereinafter referred to as "radiography") tests. Test in presence of Departmental Representative.

.2 Hydrostatically test welds to requirements of ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 10 % of welds, selected at random by Departmental Representative.

.5 Replace welds of poor or doubtful quality at Contractor's expense.

.6 In the event of weld rejection, the Departmental Representative has the right to insist on further testing at the Contractor's cost. Repairs will also be at the Contractor's cost.

.7 Leave welds uncovered until inspected and approved by Departmental Representative or Boiler Inspection Branch.

3.6 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.8 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC

.2 Section 23 05 53.01 - Mechanical Identification

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-14.5-M88, Thermometers, Bi-metallic, Self Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

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

.2 Submit shop drawings for following items.

.1 Thermometers.

.2 Pressure gauges.

.3 Stop cocks.

.4 Wells.

.3 Quality Control Check Sheets

.4 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 - Quality Control: Construction.

.3 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Thermometer make and model.

.2 Compliance of thermometer with specified requirements.

.3 Confirm thermometers installed in locations indicated on drawings and in specifications.

.4 Pressure gauge make and model.

.5 Compliance of pressure gauge with specified requirements.

.6 Pressure gauges installed in locations indicated on drawings and in specifications.

.5 For each tabulated item, identify any areas of non compliance and the proposed action to make it compliant.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Select thermometers and pressure gauges so that their operating range falls in the middle half of the scale range.

2.2 DIRECT READING THERMOMETERS

.1 Minimum Requirements:

.1 All thermometers to be in accordance with Canadian General Standards Board CGSB 14.5-M88.

.2 All thermometers shall be non-mercury type.

.3 Pipe mounted stem type - liquid actuated, adjustable angle type.

.4 Refer to flow schematics for location of pipe mounted thermometers and wells.

.5 Industrial, variable angle type, liquid filled.

.2 Case:

.1 Stem type - cast aluminum alloy, either anodized or coated with baked enamel. The case shall be provided with a clear glass or heat resistant plastic window.

.3 Scale:

.1 Stem type - 225 mm scale length.

.2 White background with temperature range in black.

.3 Dual Celsius and Fahrenheit scale.

.4 Acceptable Manufacturers:

.1 Marsh, Moeller, Trerice, Weiss, Weksler, Winters.

2.3 THERMOMETER WELLS

.1 For copper pipe use copper or bronze. For steel pipe use brass or stainless steel, separable socket, 3/4 NPT.

.2 Thermowell to be registered with Provincial Boiler and Pressure Vessels Safety Branch with CRN number.

2.4 PRESSURE GAUGES

.1 Minimum Requirements:

.1 All gauges to be in accordance with ANSI B40.100.

.2 112 mm dial type cast aluminum, black steel or stainless steel case, with stainless steel or chrome plated face ring.

.3 White background with pressure range in black.

.4 Dual kilopascal and psig scale.

.5 Phosphor bronze bourdon tube, having 0.5% accuracy.

.6 Rotary type bushed movement, silicone dampened to prevent pointer oscillation.

.7 Gauges to be registered with Provincial Boiler and Pressure Vessel Safety Branches with CRN number.

.8 ULC listed for use on fire protection systems, compressed air systems and high pressure/temperature systems.

.9 Accuracy shall be 1% off full scale over the middle half of the scale.

.2 Accessories:

.1 Install a bronze needle valve ahead of each gauge.

.2 Install an anti-syphon loop (suitable for steam pressure) ahead of each gauge on steam systems.

.3 Acceptable Manufacturers:

.1 Marsh, Moeller, Trerice, Weiss, Weksler, Winters.

Part 3 Execution

3.1 GENERAL

.1 Install thermometers and gauges so they can be easily read from floor or platform.

.2 Install between equipment and first fitting or valve, or as indicated.

3.2 THERMOMETERS

.1 Install in wells on all piping. Provide heat conductive material inside wells.

.2 Install the separable well so as to minimize the restriction to flow and, if necessary, install in a section of oversized pipe.

.3 Install wells where indicated for use with test thermometers.

.4 Install in locations as indicated.

.5 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of PRV's.

.3 In other locations as indicated.

.2 Use extensions where pressure gauges are installed through insulation.

.3 Where a single gauge is used to measure multiple points provide needle valves to isolate each point, including pressure gauge.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates, as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for bronze valves.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).

.1 ANSI/ASME B1.20.1-1983 (R2006), Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.18-2005, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.

.2 ASTM B283-10a, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.3 ASTM B505/B505M-10, Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.1 MSS-SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.

.3 MSS-SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit following shop drawings:

.1 Valves specified in this section.

.2 Provide a valve schedule and indicate the proposed system(s) where each valve type will be used.

.3 Quality Control Check Sheets.

1.5 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 - Quality Control: Construction.

.3 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets for each valve type to include the following information:

.1 Valve type – bronze gate valve, bronze globe valve, ball valve, etc.

.2 Itemize a check list for each type of valve:

.1 Material.

.2 Pressure rating.

.3 Seals.

.4 Handle.

.5 Connection.

.6 Pipe material and specifications.

.3 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

.1 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 All products to have CRN registration numbers.

.2 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.

.2 Copper tube systems: Solder ends to ANSI/ASME B16.18.

.3 Gate Valves:

.1 Requirements common to gate valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: screwed.

.3 Connections: soldered or screwed with hexagonal shoulders.

.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Packing: non-asbestos.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, screwed:

.1 Rising stem, solid wedge disc, Class 125.

.2 Body: bronze with long disc guides.

.3 Disc: solid wedge, bronze to ASTM B283, loosely secured to stem.

.4 Operator: Handwheel.

.3 NPS 2 and under, soldered:

.1 Rising stem, solid wedge disc, Class 125.

.2 Body: bronze with long disc guides.

.3 Operator: Handwheel.

.4 Globe Valves:

.1 Requirements common to globe valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: screwed.

.3 Connections: soldered or screwed with hexagonal shoulders.

.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, screwed, Class 125:

.1 Bronze body and bonnet: screwed bonnet.

.2 Rising stem.

.3 Disc and seat: renewable composition or bronze disc (composition to suit service conditions), regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.4 Operator: Handwheel.

.3 NPS 2 and under, soldered, Class 125:

.1 Bronze body and bonnet: union bonnet.

.2 Disc and seat: renewable composition or bronze disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: Handwheel.

.5 Check Valves:

.1 Requirements common to check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Connections: screwed with hexagonal shoulders.

.2 Swing Check Valves:

.1 NPS 2 and under, screwed:

.1 Bronze swing disc, Class 125.

.2 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.3 Seat: regrindable.

.2 NPS 2 and under, soldered:

.1 Bronze swing disc, Class 125:

.2 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.3 Seat: regrindable.

.6 Silent Check Valves:

.1 NPS 2 and under, screwed:

.1 Class 125. Screwed ends to ANSI B1.20.1 and with hex. shoulders.

.2 Cast high tensile bronze body to ASTM B62, bronze trim, stainless steel spring, (heavy duty spring in vertical down flow application).

.3 Seat: regrindable.

.4 Disc and seat: renewable rotating disc.

.7 Ball Valves:

.1 NPS 2 and under, screwed to ANSI B1.20.1 with hexagonal shoulders:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class 125.

.3 Forged brass body and cap, threaded cap, chrome plated ball, PTFE seats, blow out proof stem.

.4 Ball and seat: replaceable stainless steel solid ball and teflon seat.

.5 Ball valves for isolation service shall have a large/full port.

.6 Ball valves for balancing service shall have a reduced port, characterizing disc and valve handle shall have a memory stop.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.2 NPS 2 and under, soldered:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class 125.

.3 Forged brass body and cap, threaded cap, chrome plated ball, PTFE seats.

.4 Ball and seat: replaceable stainless steel solid ball and teflon seat.

.5 Ball valves for isolation service shall have a large/full port.

.6 Ball valves for balancing service shall have a reduced port, characterizing disc and valve handle shall have a memory stop.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.8 Balancing Valves:

.1 All Balancing Valves shall be Circuit Balancing Valves.

.2 NPS 2 and under: copper alloy body, screwed, 'Y' pattern globe.

.3 NPS 2-1/2 and over: cast iron body, flanged or grooved, 'Y' pattern globe.

.4 Maximum pressure 1715 kPa and maximum temperature 121°C.

.5 Calibrated balancing valve with memory, positive shut-off, inlet and outlet pressure measuring connections with integral shut-offs and drains.

.6 Calibration charts and adjustment tools to be included.

.7 Provide one (1) differential pressure meter kit suitable for direct readout c/w connection hoses suitable for the system pressure.

.8 Acceptable Products:

.1 Bell and Gossett - Circuit Setter.

.2 Tour & Andersson – STAD.

.3 Armstrong – CBV.

.4 Wheatley – GS.

.5 Nexus.

.9 Needle Valves

.1 Bronze body, screwed, globe type with cadmium plated steel stem.

.2 Class 400 pressure.

Part 3 Execution

3.1 INSTALLATION

.1 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

.2 Remove internal parts before soldering.

.3 Install valves with stems upright or angled 45^0 above horizontal unless approved otherwise.

.4 Use gate valves or (ball valves NPS 2 and under) to shut off branch takeoffs and to isolate supply and return piping at equipment.

.5 Use globe valves to control flow in circuits; except, where circuit balancing valves are specifically specified or indicated.

.6 Install circuit balance valves in the return piping connections to each terminal heating unit – e.g. unit heaters, heating coils, etc.

.7 Provide isolation valves in all systems such that large branch pipes can be isolated.

.8 Provide valves upstream of all mechanical equipment including meters, gauges, automatic air vents, etc. for isolation purposes.

.9 Use swing check valves, in horizontal and vertical upflow pipes and on the discharge of pumps. Spring loaded water check valves shall be located 8 pipe diameters downstream of pumps or elbows.

.10 Install needle valves where petcocks or manual vents are indicated.

3.2 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for cast iron valves.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 05 - Installation of Pipework.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).

.1 ANSI/ASME B16.1-2005, Gray Iron Pipe Flanges and Flanged Fittings.

.2 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.1 MSS SP-67-2002, Butterfly Valves.
.2 MSS SP-70-2008, Cast Iron Gate Valves, Flanged and Threaded Ends.
.3 MSS SP-71-2010, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
.4 MSS SP-82-2002, Valve Pressure Testing Methods.
.5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.4 SUBMITTALS

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

.2 Submit following shop drawings:

.1 Valves specified in this section.
.2 Provide a valve schedule and indicate the proposed system(s) where each valve type will be used.

.3 Quality Control Check Sheets.

.4 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.
.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 – Quality Control: Construction.
.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet.

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets for each valve type to include the following information:

.1 Valve type – cast iron gate valve, cast iron globe valve, etc.

.2 Itemize a check list for each type of valve:

.1 Material.

.2 Pressure rating.

.3 Seals.

.4 Handle.

.5 Connection.

.6 Pipe material and specifications.

.3 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.6 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIAL

.1 Valves:

.1 Except for specialty valves, to be of single manufacturer.

.2 Standard specifications:

.1 Butterfly valves: MSS SP-67.

.2 Gate valves: MSS SP-70.

.3 Globe valves: MSS SP-85.

.4 Check valves: MSS SP-71.

.3 Requirements common to valves, unless specified otherwise:

.1 Body, bonnet: cast iron to ASTM B209 Class B.

.2 Connections: flanged ends plain face to ANSI B16.1.

.3 Inspection and pressure testing: to MSS SP-82.

.4 Bonnet gasket: non-asbestos.

.5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

.6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

.7 Gland packing: non-asbestos.

.8 Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.

.9 Identification tag: with catalogue number, size, other pertinent data.

.4 All products to have CRN registration numbers.

2.2 BUTTERFLY VALVES

.1 NPS 2 ½ and over, class 200.

.1 Cast or ductile iron body, lug or grooved ends, stainless steel stem, extended neck.

.2 Disc: Aluminum bronze.

.3 Seat: Resilient replaceable EPDM.

.4 Handle and Operator: Infinite position lever handle with memory stop. Furnish gear operators for valves 8 inches and larger, and chain wheel operators for valves mounted over 2400mm above floor.

.5 Acceptable Manufacturers:

.1 Crane, Grinnell, Kitz, Milwaukee, Nibco, Toyo.

2.3 GATE VALVES

.1 NPS 2 ½ and over, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:

.1 Cast iron body, multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.

.2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 75 mm (3in), cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.

.3 Seat rings: renewable bronze screwed into body.

.4 Stem: nickel-plated steel.

.5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.

.6 Seat rings: integral with body.

.7 Stem: nickel-plated steel.

.8 Pressure-lubricated operating mechanism.

.9 Operator: Handwheel.

.10 Acceptable Manufacturers:

.1 Crane, Grinnell, Kitz, Newman Hattersley, Nibco, Toyo.

2.4 GLOBE VALVES

.1 NPS 65 mm (2½in) and over, OSY:

.1 Body: with multiple-bolted bonnet.

.2 WP: 860 kPa steam, 1.4 MPa CWP.

.3 Bonnet-yoke gasket: non-asbestos.

.4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

.5 Seat ring: renewable, regrindable, screwed into body.

.6 Stem: bronze to ASTM B62.

.7 Operator: Handwheel.

.8 Bypass: complete with union and NPS ¾ globe valve as Section 23 05 23.01 - Valves – Bronze.

2.5 VALVE OPERATORS

.1 Install valve operators as follows:

.1 Handwheel: on valves except as specified.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms and mechanical equipment rooms.

2.6 CHECK VALVES

.1 Swing check valves, Class 125:

.1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.

.1 Up to NPS 400 mm (16in): cast iron to ASTM A126 Class B.

.2 Ratings:

.1 NPS 65 – 300 mm (2½ - 12in): 860 kPa steam; 1.4 MPa CWP.

.3 Disc: rotating for extended life.

.1 Up to NPS 150 mm (6in): bronze to ASTM B 62.

.2 NPS 200 mm (8in) and over: bronze-faced cast iron.

.4 Seat rings: renewable bronze to ASTM B62 screwed into body.

.5 Hinge pin, bushings: renewable bronze to ASTM B62.

.6 Disc: A126 Class B, secured to stem, rotating for extended life.

.7 Seat: cast iron, integral with body.

.8 Hinge pin: exelloy; bushings: malleable iron.

.9 Identification tag: fastened to cover.

.10 Hinge: galvanized malleable iron.

.2 Swing check valves, NPS 65 – 200 mm (2½ - 8in) Class 250:

.1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.

.2 Flanged ends: 2 mm raised face with serrated finish.

.3 Rating: 1,724 kPa (250 psi) steam; 3,447 kPa (500 psi) CWP.

.4 Disc: rotating for extended life.

.1 Up to NPS 75 mm (3in): bronze to ASTM B61.

.2 NPS 100 – 200mm (4 – 8in): Iron faced with ASTM B61 bronze.

.5 Seat rings: renewable bronze to ASTM B61, screwed into body.

.6 Hinge pin, bushings: renewable, bronze to ASTM B61.

.7 Hinge: galvanized malleable iron.

.8 Identification tag: fastened to cover.

2.7 SILENT CHECK VALVES

.1 Construction:

.1 Body: malleable or ductile iron with integral seat.

.2 Pressure rating: class 125, WP = 862 kPa.

.3 Connections: grooved ends.

.4 Disc: bronze or stainless steel renewable rotating disc.

.5 Seat: renewable, EPDM.

.6 Stainless steel spring, heavy duty (for downflow application).

Part 3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Bases, pads, hangers and supports for mechanical piping, ducting and equipment, provided in Divisions 23 and 25.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 49.01 - Seismic Restraint Systems.

1.3 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):

.1 ANSI/ASME B31.1-2012, Power Piping.

.2 American Society for Testing and Materials International (ASTM):

.1 ASTM A125-1996 (R2007), Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-10, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

.1 MSS SP58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.4 Thermal Insulation Association of Canada (TIAC) Mechanical Insulation Best Practices Guide.

1.4 SUBMITTALS

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

.2 Shop drawings: submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.

.3 Submit shop drawings and product data for following items:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

.6 Quality Control Check Sheets.

1.5 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 - Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet.

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Pipe or ductwork system.

.2 Equipment number, make and model, including weights.

.3 Pipe support type and spacing.

.4 Details of pipe attachment to structure.

.5 Hanger details at pipe insulation (where applicable and specified).

.6 Comments on seismic installation.

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and supports to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 and ASME B31.1.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

.6 Provide hangers and supports to secure equipment in place, prevent vibration, protect appropriate against damage from earthquake, maintain grade, provide for expansion and contraction and accommodate insulation.

.7 Provide insulation protection saddles on all insulated piping.

.8 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP58.

.9 Set inserts in position in advance of concrete work. Use grid system in equipment rooms.

.10 Support from (top of) structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members, as necessary.

.11 Do not suspend from metal deck.

.2 Performance Requirements:

.1 Design supports, platforms, catwalks, hangers, to withstand seismic events as specified Section 23 05 49.01 - Seismic Restraint Systems.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

.1 General Finishes:

.1 Finishes for hangars, attachments and pipe supports in crawlspace (Level 0):

.1 Electrogalvanized finish, due to the potential for corrosion over the long term.

.2 Level 0 is exposed to the ocean environment (salty corrosive air).

.2 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 All attachments and pipe support components in Level 0 (crawlspace) shall have electro-galvanized finish.

.3 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm ULC listed.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, ULC listed to MSS-SP58 and MSS-SP69.

.4 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, ULC listed to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut ULC listed.

.5 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate, ULC listed to MSS SP69.

.3 Concrete inserts for existing concrete slabs: Refer to Section 03 30 00 – Cast-in-Place Concrete for requirements.

.6 Steel Joist:

.1 Cold piping NPS 2 and under: steel washer plate with double locking nuts.

.2 Cold piping NPS 2-1/2 and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.

.7 Steel Channel or Angle (bottom):

.1 Cold piping NPS 2 and under; malleable iron C clamp.

.2 Cold piping NPS 2-1/2 and larger and all hot piping; universal channel clamp.

.8 Steel Channel or Angle (top):

.1 Cold piping NPS 2 and under: malleable iron "top of beam" C clamp.

.2 Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer.

.9 Hanger rods: threaded rod material to MSS SP58:

.1 Carbon steel black continuous threaded rod.

.2 Carbon steel black continuous threaded rod with electro-galvanized finish in Level 0 (crawlspace).

.3 Ensure that hanger rods are subject to tensile loading only.

.4 Provide linkages where lateral or axial movement of pipework is anticipated.

.5 Do not use 22 mm or 28 mm rod.

.10 Pipe attachments: material to MSS SP58:

.1 All attachments in areas exposed to moisture shall have electro-galvanized finish.

.2 Cold piping, steel or cast iron: hot piping steel, with less than 25 mm horizontal movement; hot piping, steel, with more than 300 mm rod length: adjustable clevis.

.3 Cold copper piping; hot copper piping with less than 25 mm horizontal movement; hot copper piping with more than 300 mm rod length: adjustable clevis copper plated.

.4 Suspended hot piping, steel and copper, with horizontal movement in excess of 25 mm; hot steel piping with middle attachment (rod) 300 mm or less; pipe roller.

.5 Bottom supported hot piping, steel and copper: pipe roller stand.

.6 Spring hangers; where required to offset expansion on horizontal runs which follow long vertical risers.

.7 See Clause 2.4 for insulation shields.

.8 Oversize pipe hangers and supports, for insulated hot pipework, to avoid penetrating the insulation vapour barrier.

.11 Adjustable clevis: material to MSS SP69, ULC listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis, for stiffening during seismic event.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.12 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.13 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black (electro-galvanized finish in Level 0).

.2 Finishes for copper pipework: black, with formed portion plastic coated or epoxy coated.

.14 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: black carbon steel to MSS SP58, type 42, ULC listed.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

.1 General

.1 On insulated piping larger than 25mm diameter where insulation possesses a continuous vapour barrier, install oversized hangers and insulation protection shields of thickness and length as recommended by the manufactures.

.2 On insulated piping 25mm and less, protect contact between pipe and hanger and fit insulation tightly around hanger rod penetration through insulation.

.2 Insulated cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Uninterrupted vapour barrier.

.3 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, carbon steel to comply with MSS SP69.

2.5 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.6 WALL SUPPORTS

.1 Horizontal and Vertical pipe adjacent to wall.

.1 Do not support piping from the wall unless specifically indicated.

2.7 FLOOR SUPPORTS

.1 Horizontal pipe.

.1 Exposed pipe floor support for lateral movement restraint.

.2 Galvanized or other non-corrosive finish.

.3 Channel type support - Burndy, Canadian Strut, Cantruss or Unistrut, type support.

.4 Angle iron wall brackets (galvanized or other non-corrosive finish) with specified hangers.

.5 Refer to Section 23 05 49.01 - Seismic Restraint Systems.

2.8 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

.2 Calculations shall be signed and sealed by Professional Engineer certified to practice in BC.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.10 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

2.11 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel.

.2 Submit structural calculations with shop drawings, signed and sealed by Professional Engineer certified to practice in British Columbia.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, vibrating equipment and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

.1 Spacing and middle attachment (rod) diameter as specified in paragraphs below or as in table below or as indicated, whichever is more stringent.

.1 Plumbing piping: to National Plumbing Code of Canada.

.2 Fire protection: to applicable fire code; toggle hangers are unacceptable.

.3 For Natural Gas Piping refer to Gas Code CAN/CGA-B149.1. Up to NPS ½: every 1.8m.

.4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.5 Within 300 mm of each horizontal elbow, tee, joints, etc.

Maximum Hanger Spacing Table

Pipe Size: NPS	Rod Diameter mm	Maximum Spacing Steel Pipe m	Maximum Spacing Copper Pipe m
½	10	1.8	1.5
¾, 1	10	2.4	1.8
1¼ , 1½	10	3.0	1.8
2	10	3.0	3.0
2½ , 3, 4	12	3.0	3.0
5, 6, 8	16	3.0	

.2 Maximum hanger spacing for flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	

3.4 HANGER INSTALLATION

.1 Offset hanger so that rod is vertical in operating position.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

.4 Install hanger to provide minimum 12 mm clear space between finished covering and adjacent work.

.5 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.6 Where practical, support riser piping independently of connected horizontal piping.

.7 Install plastic inserts between steel studs and piping.

.8 For beam clamps, extend hanger rod tight to underside of beam with top bolt and washer.

3.5 INSERTS

.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying piping over 100 mm or ducts over 1500 mm wide.

.3 Where concrete slabs form finished ceiling, finish inserts, flush with slab surface.

.4 Where inserts are omitted or where inserts are required in existing concrete slabs, refer to Section 03 30 00 – Cast-In-Place Concrete for insert requirements.

.5 Provide inserts for piping/equipment above chillers, pumps and sump pumps to permit equipment servicing. Provide an eyebolt.

.6 Inserts shall be installed in accordance with manufacturer's recommendations and in no case closer than 2.1 m apart.

3.6 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.7 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.8 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.9 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Vibration isolation materials and components, seismic control measures and their installation for equipment and systems provided in Divisions 23 and 25.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 49.01 - Seismic Restraint Systems.

1.3 REFERENCES

.1 National Building Code of Canada (NBC) – 2010.

1.4 SUBMITTALS

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

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

.3 Provide detailed drawings of seismic control measures for equipment and piping.

.3 Quality Control Check Sheets.

.4 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 - Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet.

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Installation matches sealed shop drawings.

.2 Isolation provide for all vibrating equipment.

.3 Corrosion protection for outdoor isolators.

.4 Review site reports from supplier.

.5 Supplier’s statutory declaration – see Clause 3.3.2.

.5 For each tabulated item, identify any areas of non compliance and the proposed action to make it compliant.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Provide vibration isolation on all motor driven equipment with motors of 1/2 HP and greater power output (as indicated on the motor nameplate) and on piping, as specified herein. For equipment less than 1/2 HP, provide vibration isolation grommets at the support points.

.2 Provide seismic restraint for all equipment including all seismic restraint related hardware (bolts and anchors) from point of attachment to equipment through to and including attachment to structure. The required anchors shall be indicated on the shop drawings and shall be clearly identified for the correct location and so as to be readily identified after installation. Provide clear instructions for their installation. Refer to Section 23 05 49.01 - Seismic Restraints Systems.

.3 Place isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the centre of gravity of the equipment. Include height of centre of gravity on shop drawings. Otherwise, design for increased forces on the supports, and submit design calculations with shop drawings for approval.

.4 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified. Use dynamic stiffness correction factors for elastomers and do not exceed 60 durometer.

.5 Isolators and restraining devices, which are factory supplied with equipment, shall meet the requirements of this section.

.6 Provide concrete inertia bases or structural steel bases, where specified or required by equipment manufacturers, located between vibrating equipment and the vibration isolation elements, unless the equipment manufacturer certifies direct attachment capabilities. Coordinate with Division 3 for the provision of concrete work.

.7 Coordinate for the provision of housekeeping pads at least 100 mm high under all isolated equipment, or greater thickness where specified. Provide at least 300 mm clearance between drilled inserts and edge of housekeeping pads. Housekeeping pads to be tied to structure with reinforcement to meet Code seismic requirements.

.8 For isolated equipment, design anchors, bolts, isolators and bases to meet Code requirements.

.9 Use ductile materials in all vibration and seismic restraint equipment.

.10 Provide flexible connectors between equipment and piping where required by manufacturers to protect equipment from stress and reduce vibration in the piping system. Meet connector manufacturer's installation specifications as well as equipment manufacturer's requirements.

.11 Coordinate with Electrical Division 26 for the provision of a minimum 180^0 hanging loop of flexible conduit for all electrical connections to isolated equipment.

.12 Supply all isolators fully assembled and clearly labelled with full instructions for installation by the contractor.

2.2 ISOLATORS - GENERAL

.1 Supply all of the vibration isolation equipment by one approved supplier with the exception of isolators, which are factory installed and are standard equipment with the machinery. Confirm with manufacturer that these factory-installed isolators meet the seismic requirements of this specification.

.2 Select isolators at the supplier's optimum recommended loading and do not load beyond the limit specified in the manufacturer's literature.

.3 Design springs "iso-stiff" (kx/ky = 1.0 to 1.5) with a working deflection between 0.3 and 0.6 of solid deflection.

.4 Provide hot dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for all isolation equipment located out of doors or in areas where moisture may cause corrosion.

2.3 ISOLATORS – TYPE 1, PADS

.1 Neoprene or neoprene / steel / neoprene pad isolators. Select Type 1 pads for a minimum 2.5 mm static deflection or greater. Use hold down bolts selected for seismic loads. Isolate bolts from base of unit using neoprene hemi-grommets. Avoid over-compressing grommets. Size bolt and hemi-grommet for minimum lateral clearance. Use grommets only on light-weight equipment.

2.4 ISOLATORS – TYPE 2, RUBBER FLOOR MOUNTS

.1 Rubber/neoprene-in-shear isolators designed to meet specified seismic requirements. Select isolators for a 4 mm minimum static deflection, and bolt to structure. In the case of rubber isolators, provide protection in the design of the isolator to avoid contact of the rubber element to oil in the mechanical room.

2.5 ISOLATORS – TYPE 3, SPRING FLOOR MOUNTS

.1 Spring mounts complete with levelling devices, selected to achieve 25 mm deflection under load. Springs to incorporate a minimum 6 mm thick neoprene sound pad or cup having a 1.3 mm minimum deflection under load. Design isolator to meet specified seismic requirements.

.2 Outdoor or moist installations: Zinc or cadmium plated springs and hardware; housings coated with rust resistant paint.

.3 Colour code springs.

2.6 ISOLATORS – TYPE 4, HANGER MOUNTS

.1 Spring hangers, c/w 6 mm thick neoprene cup/bushing sized for 1.3 mm minimum deflection, or neoprene hangers.

.2 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.3 Outdoor or moist installations: Zinc or cadmium plated springs and hardware; housings coated with rust resistant paint.

2.7 CLOSED CELL FOAM GASKETS/NEOPRENE GROMMETS – TYPE 7

.1 20 mm thick continuous perimeter closed cell foam gasket to isolate base of package type equipment, AHU's, exhaust fans, etc. from concrete floors / roof curbs. Select width for nominal 20 kPa loading under weight of equipment and allow for 25% compression 5mm. Increase width of curb using steel shim if necessary to accommodate gasket. For light equipment such as exhaust fans, deflection should be a minimum of 1.3 mm. Contractor to check fire rating requirements specified for project.

2.8 STEEL BASES

.1 Construct structural steel bases sufficiently rigid to keep deflection and misalignment within acceptable limits as determined by the equipment manufacturer.

.2 Steel bases supplied as integral part of equipment to be supplied meeting the above requirements.

.3 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.9 SEISMIC CONTROL MEASURES

.1 General:

- .1 Seismic control systems to work in every direction.
- .2 Fasteners and attachment points to resist same maximum load as seismic restraint.
- .3 Drilled or power driven anchors and fasteners not permitted.
- .4 No equipment, equipment supports or mounts to fail before failure of structure.
- .5 Supports of cast iron or threaded pipe not permitted.
- .6 Seismic control measures not to interfere with integrity of firestopping.

.2 Static equipment:

- .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
- .2 Suspended equipment:
  - .1 Use one or more of following methods depending upon site conditions or as indicated:

.1 Install tight to structure.

.2 Cross brace in every direction.

.3 Brace back to structure.

.4 Cable restraint system.

.3 Seismic restraints:

.1 Cushioning action gentle and steady.

.2 Never reach metal-like stiffness.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.4 Piping systems:

.1 Piping systems: hangers longer than 300 mm; brace at each hanger.

.2 Compatible with requirements for anchoring and guiding of piping systems.

.5 Bracing methods:

.1 Structural angles or channels.

.2 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

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 Seismic control measures to meet requirements of NBC 2010.

.2 Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

.3 Ensure piping and electrical connections to isolated equipment do not reduce system flexibility and that piping and conduit passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

.7 Execute the work in accordance with the specifications and, where applicable, in accordance with the manufacturer's instructions and only by workmen experienced in this type of work.

.8 For all equipment mounted on vibration isolators, provide a minimum clearance of 50 mm to other structures, piping, equipment, etc.

.9 Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing (seismically rated) anchors and/or welding.

.10 After installation and adjustment of isolators verify deflection under load to ensure loading is within specified range and isolation is being obtained.

.11 Where hold down bolts for isolators or seismic restraint equipment penetrate roofing membranes, provide "gum cups" and sealing compound to maintain waterproof integrity of roof. Ensure sealing compound is compatible with isolator components such as neoprene. Co-ordinate with roofing section of specifications and with roofing subcontractor.

.12 Select Type 4 spring hangers for a minimum static deflection of 25 mm for all ceiling hung fans and other vibrating sources.

.13 Isolate pumps and axial fans rotating at more than 1170 RPM on type 2 isolators.

.14 Use the lowest RPM scheduled for two-speed equipment in determining isolator deflection.

.15 Ensure that pumps are installed and aligned such that no piping loads are imposed on the pump. Pumps and piping should be independently supported and aligned prior to final connection.

.16 Where piping, connected to or serving noise generating equipment, is routed through walls, floors, piping chases, etc. position piping, stacks, etc. to avoid contact with the concrete structure, future framing, drywall and other finishes which may radiate noise. Use Type 2 mounts. Submit proposed details to meet this requirement.

.17 Provide stabilizing springs limiting movement at flexible connections to 25% of fabric width under steady state conditions and 40% at start up.

.18 Floor or pier mounted equipment: Isolate all floor or pier mounted equipment on Type 3 isolators, unless otherwise specified.

.19 Slab mounted equipment: For equipment mounted on a slab, mount on type 2 isolators unless otherwise specified.

.20 Pumps: Mount in-line pumps on two (2) Type 2 isolators under each support foot.

3.3 INSPECTIONS

.1 The supplier shall provide assistance to the contractor as necessary during the course of installation of isolation equipment.

.2 The supplier shall inspect the complete installation after system startup and establish that the isolators for each piece of equipment are properly installed and adjusted. Correct any mal-performance. The supplier shall submit a statutory declaration to the Departmental Representative stating that the complete vibration isolation installation is installed in accordance with his drawings and instructions and operates to his satisfaction.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 After preparatory work is complete but before installation commences.

.2 Once during the installation, at 50% completion stage.

.3 Upon completion of installation.

.3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.

.4 Make adjustments and corrections in accordance with written report.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Seismic restraint systems (SRS) for statically supported and vibration isolated equipment and systems provided in Divisions 23 and 25; including all mechanical equipment, mechanical distribution systems, fire protection, both vibration isolated and statically supported.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.3 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.4 Section 26 19 50 - Seismic Restraint for Electrical Systems.

1.3 REFERENCES

.1 National Building Code of Canada (NBC) – 2010.

.2 Canadian Standards Association (CSA International):

.1 CSA 832-06 (R2011) Guideline for seismic risk reduction of operational and functional components (OFCS) of buildings.

.2 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.4 DEFINITIONS

.1 SRS: acronym for Seismic Restraint System.

1.5 SEISMIC CRITERIA AND INSPECTION REQUIREMENTS

.1 Seismic Criteria for the design of Seismic Restraint System are as follows:

.1 Refer to Drawing S0.01.

.2 I_E = 1.3 (importance factor).

.3 F_a=1.1 (acceleration base site coefficient).

.4 C_p: Seismic coefficient for mechanical equipment (NBCC 2010 table 4.1.8.18).

.5 A_r = 2.5: Response amplification factor to account for type of attachment of mechanical equipment (NBCC 2010 table 4.1.8.18).

.6 R_p: Element or component response modification factor (NBCC 2010 table 4.1.8.18).

.2 Comply with CSA S832-06 (R2011) Seismic Risk Reduction of Operational and Functional Components (OFCS) of Buildings.

.3 Arrange and pay for the services of a BC registered Professional Structural Engineer. This Structural Engineer, herein referred to as the Seismic Engineer shall provide all required engineering services related to seismic restraints of mechanical equipment, accessories and services and encompasses all the attachments at the equipment and at the structure. Submit a Letter of Assurance of Professional Design and Commitment for field review of the seismic restraint installation prior to commencement of construction activities & submission of shop drawings and provide a Letter of Assurance for Field Review upon completion of the project. Use BC Building Code Schedule S-B and S-C.

.4 Seismic Engineer shall provide assistance to the contractor as necessary during the course of equipment installation.

.5 Seismic Engineer shall inspect the completed seismic installation and shall submit a letter of assurance to the Departmental Representative stating that the complete seismic installation is installed in accordance with his drawings and that it complies with the regulatory requirements, codes and standards.

1.6 SCOPE OF WORK

.1 Provide restraint on all piping, ductwork and equipment, which is part of the building mechanical systems to prevent injury or hazard to persons and equipment and to retain equipment in its normal position in the event of an earthquake.

.2 Provide all seismic restraint related hardware, (including bolts and anchors) from point of attachment to equipment through to and including attachment to structure.

.3 When equipment is mounted on concrete housekeeping pads, and/or concrete curbs the anchor bolts shall extend through the pad into the structure.

.4 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

.5 Designed by Professional Engineer specializing in design of SRS and registered in Province of British Columbia.

1.7 SUBMITTALS

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

.2 Shop drawings: submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.

.1 Note that the shop drawings must be specific to this project, with reference and drawings showing attachment to the existing or new structure.

.2 Seismic Engineer to visit site to survey the existing conditions, before submitting the shop drawings.

.3 Generic shop drawings that do not reflect the actual site conditions will be rejected.

.3 Submit design data including:

.1 Full details of design criteria.

.2 Working drawings (prepared to same standard of quality and size as documents forming these tender documents), materials lists, schematics, full specifications for components of each SRS to be provided.

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

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

.5 Identification of location of devices.

.6 Schedules of types of SRS equipment and devices.

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

.8 Installation procedures and instructions.

.9 Design calculations including restraint loads to NBC and Supplement.

.10 Detailed work sheets, tables.

.11 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract Documents, materials lists, design calculations, schematics, specifications.

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.5 Certificate of Compliance from Contractor’s Seismic Engineer.

.6 Closeout Submittals:

.1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.

1.8 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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 Attachments to reinforced concrete structure:

.1 Use high strength mechanical expansion anchors.
.2 Drilled or power driven anchors not permitted.

.7 Wet pipe sprinkler systems: refer to Section 21 13 13 - Wet Pipe Sprinklers.

.8 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 Departmental 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 GENERAL

.1 It is the responsibility of the contractor to ascertain that an appropriate size device be selected for each individual piece of equipment.

.2 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 NON-ISOLATED FLOOR MOUNTED EQUIPMENT

.1 Bolt all non-isolated equipment to the structure.

.2 Design anchors and bolts for seismic force applied horizontally through the centre of gravity. For equipment, which may be subject to reasonances, use a nominal 2.0g seismic force.

3.3 ISOLATED PIPING AND EQUIPMENT

.1 Install cables using appropriate grommets, shackles, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connecting points.

.2 Connect slack cable restraints to ceiling hung equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.

.3 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45 degrees to the slab.

.4 On piping systems, provide transverse slack cable restraints at a maximum spacing of 10 m and longitudinal restraints at 20 m maximum spacing, or as limited by anchor/slack cable performance. For pipes greater than NPS10, reduce transverse restraint spacings to 6.0 m.

.5 Small pipes may be rigidly tied to big pipes for restraint, but not the reverse.

.6 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe connected perpendicular to it, provided the bracing is installed within 600 mm of the elbow or T, and if the connected pipe is the same or smaller in size. Do not use branch lines to restrain main lines.

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

.8 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. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed the transverse spacings discussed above for horizontal pipes, with guide clearance not exceeding 3 mm.

.9 Vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonances.

.10 Install restraints at least 50 mm clear of all other equipment and services.

.11 Adjust restraint cables such that they are not visibly slack, or such that the flexibility is approximately 40 mm under thumb pressure for a 1.5 m cable length (equivalent ratio for other cable lengths). Adjust the clearance at cable strap/spacer piece restraints to not exceed 6 mm.

.12 Provide transverse and axial restraints as close as practical to a vertical bend.

.13 At steel trusses, connect to top chords and follow truss manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 After delivery and storage of Products.

.2 After preparatory work is complete but before installation commences.

.3 Twice during the installation, at 25% and 60% completion stages.

.4 Upon completion of installation.

.3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.

.2 Inspection and Certification:

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

.2 Provide written report to Departmental Representative with certificate of compliance.

.3 Commissioning Documentation:

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

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

1.3 REFERENCES

.1 Canadian Gas Association (CGA).

.1 CSA/CGA B149.1-10, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA).

.1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.

1.4 SUBMITTALS

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

.2 Shop drawings to indicate the following:

.1 Legend of proposed identification details for each system.

.2 Details of proposed nameplates, labels and tags.

.3 Samples:

.1 Provide a sample of a typical nameplate, label and tag for review and approval of Departmental Representative.

.2 Provide a mock up of each type of piping identification.

.4 Quality Control Check Sheets.

.5 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 – Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet.

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Pipe type – HW piping, etc.

.2 Equipment type – pump, etc.

.3 Details of identification for all equipment and systems.

.4 Tabulated check list including the following:

.1 Equipment number and type.

.2 System type.

.3 Equipment and system location.

.4 Identification completed.

.5 Spacing as specified.

.6 Visible from all areas.

.7 Match existing identification.

.8 Corrosion resistant nameplates, tags and ties.

.9 Valve schedule and identification chart.

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.1 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Dispose of unused paint and coating material at official hazardous material collections site approved by Departmental Representative.

.3 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 GENERAL

.1 Scope of Work includes identification of all mechanical equipment and services within the area of this project.

2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Corrosion resistant metal or lamacoid nameplate, mechanically fastened to each piece of equipment by manufacturer.

.2 Include ULC, (Underwriters' Laboratories Canada) or CSA, (Canadian Standards Association) registration logos and those of other agencies, as required by the respective agencies.

.3 Nameplates shall be located so that they are easily read. Do not insulate or paint over nameplates.

.4 Lettering and numbers raised or recessed.

.5 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.3 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic (lamacoid), matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: use size # 5.

.2 Equipment in Mechanical Rooms: use size # 9.

.5 Identify all systems and areas or zones of building being serviced.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1.

.1 Paint all natural gas piping yellow.

.2 Sprinklers: to NFPA 13.

.1 Paint all sprinkler piping red.

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

.2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic hot water recirc.	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Process (non potable) water	Green	PROCESS WATER
Storm water	Green	STORM
Sanitary (gravity)	Green	SAN
Plumbing vent	Green	SAN. VENT
Natural gas	Yellow	Natural Gas
Sprinklers	Red	SPRINKLERS

2.6 VALVES, CONTROLLERS

.1 White lamacoid tags with 12 mm engraved identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 TAGGING IDENTIFICATION

.1 Secure engraved laminated plastic identification tags (black face and white centre) on the following items:

.1 Temperature control instruments, gauges and panels, coordinated with control diagrams identification.

.2 Electrical switchgear supplied under the Mechanical Division 23 and 25.

.3 Refer also to Controls Division 25.

.4 Unit Heaters.

.5 All other installed mechanical equipment located indoors.

2.9 LANGUAGE

.1 Identification in English.

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 TIMING

.1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING SYSTEMS

.1 On long straight runs in open areas, in mechanical rooms, equipment rooms, at not more than 7.5m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas, service spaces and walking aisles.

.2 Adjacent to each change in direction greater than 90 degrees.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with UV rated plastic tie wraps.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Testing, Adjusting and Balancing (TAB) is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for all HVAC and plumbing systems in the facility.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 08 00 - Commissioning - Mechanical Systems.

.3 Section 25 90 01 - EMCS: Systems Sequences of Operations.

1.3 QUALIFICATIONS OF TAB COMPANY AND PERSONNEL

.1 Testing, Adjusting and Balancing Company shall meet the following qualifications:

.1 Minimum of ten years of recent experience in testing and balancing of mechanical systems, for a variety of industrial processes and systems.

.2 Approved TAB Companies:

.1 KD Engineering.

.2 Western Mechanical Services.

.3 MDT Systems.

.3 Companies not listed above and who wish to be approved shall submit appropriate documents demonstrating compliance with the above qualifications as per the requirements of the “Instructions to Tenderers”. Request for approval after tender closing will not be accepted.

.2 The senior site technologist must have a minimum of ten years TAB experience of similar industrial projects.

.3 Submit names of personnel to perform TAB to the Departmental Representative within 90 days of award of contract.

.4 Provide documentation confirming qualifications, successful experience.

.5 TAB: performed in accordance with the requirements of following standard:

.1 National Environmental Balancing Bureau (NEBB), Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-7th Edition (2005).

.6 Use TAB Standard provisions, including checklists, and report forms; submit final report at the completion of the project. Include report in the maintenance manual.

.7 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.8 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.9 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.4 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges (simulate filter loading, outdoor air provision, etc.)

.4 Note that there is some overlap in responsibility between this section and Section 23 08 00 - Commissioning - Mechanical Systems.

1.5 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction (such as sprinkler system, fire alarm system, etc.)

1.6 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

.3 Note that the project is phased, in an existing facility, and with a requirement to maintain all systems operating to support building operation. Consequently, TAB will be required for every phase, to set operation, before proceeding to the next phase.

1.7 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to the Departmental Representative the adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to the Departmental Representative in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.9 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.10 START OF TAB

.1 Notify Departmental Representative seven (7) days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weatherstripping, sealing, and caulking.

.3 Pressure, leakage, other tests specified elsewhere in Division 23.

.4 Provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Liquid systems:

.1 Flushed, filled, vented.

.2 Strainers in place, baskets clean.

.3 Isolating and balancing valves installed, open.

.4 Calibrated balancing valves installed, at factory settings.

1.11 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5%, minus 5%.

.2 Hydronic systems: plus or minus 10%.

1.12 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2% of actual values.

1.13 INSTRUMENTS

.1 Prior to TAB, submit to Departmental Representative a list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.14 SUBMITTALS

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

.2 Qualifications of TAB Company and Personnel.

.3 Submit, prior to commencement of TAB:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

.4 Test Reports: submit certified test reports from approved TAB Company indicating compliance with specifications for specified performance characteristics and physical properties. Include as follows:

.1 Pre-TAB review – confirmation of the adequacy of provisions of TAB.

.2 List of any standards or procedures that differ from specified standards.

.3 Preliminary TAB Report.

.4 Statutory declaration certifying that the TAB procedures have been completed.

.5 Fire Damper Test Report.

.6 Final TAB Report.

.5 Quality Control Check Sheet, itemizing all reports and certificates.

1.15 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

1.16 TAB REPORT

.1 Format in accordance with NEBB Guidelines.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit three copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index and index tabs. Provide an electronic copy (in PDF searchable format).

.4 Include final TAB report in maintenance manual.

1.17 VERIFICATION

.1 Reported results subject to verification by Departmental Representative.

.2 Provide personnel and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by Departmental Representative.

.4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.18 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, and ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.19 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

.2 Include final TAB report in the maintenance manual.

1.20 TAB GENERAL

.1 Standard: TAB to most stringent of this section or TAB standards of NEBB.

.2 Do TAB of following systems, equipment, components, controls:

.1 Heating hot water systems

.3 The TAB agency shall be responsible to the Contractor but report jointly to the Departmental Representative and the Contractor. Report in writing to the Departmental Representative any lack of cooperation and any discrepancies or items not installed in accordance with the contract documents.

.4 Procedures shall be in general accordance with AABC's National Standards for Field Measurement and Instrumentation and ASHRAE Standards.

.5 The TAB agency shall agree to perform spot checks, where requested, in the presence of the Departmental Representative.

.6 Work with the TAB agency to:

.1 Ensure that all mechanical systems are complete and ready to be balanced and provide sufficient time for testing and balancing prior to substantial performance.

.2 Make corrections to achieve system balance without delay, include all corrections made during the balancing procedure on "As Built" Drawings. Mechanical Contractor to provide “As Built” information to the balancing agency before balancing commences.

.3 Maintain all systems in full operation during the complete testing and balancing period.

.4 Employ control technicians to make adjustments to the control systems to facilitate the balancing process. TAB agent shall work with the Controls contractor to assist in verifying set-points and the control sequence parameters.

.7 Consult with the Departmental Representative to clarify the design intent where necessary or in case there are any problems foreseen as the balancing processes.

.8 Complete air balance before commencing water balance where heating/cooling coils are installed in the air system. Balancing shall not commence until systems have been cleaned and treated and the air removed from within the piping systems.

.9 This TAB agency shall remove and re-install ceiling tile to provide access to piping. The TAB agency will make good any damage or soiling caused by his forces.

.10 Permanently mark final settings on valves, dampers and other adjustment devices. Set and lock all memory stop balancing devices.

.11 The controls contractor and TAB agency are to allow for checking and making adjustments during the 12 month warranty period, when weather conditions provide natural loads and in cases where complaints arise.

.12 Submit a draft balance report to the Departmental Representative for approval and submit approved copies to the agency preparing the O & M manuals for inclusion in each operating and maintenance manual. Provide field notes in the balancing report to clearly identify unusual conditions, problem areas and report on any cases where the specified flow rates or conditions could not be achieved by adjustment. Identify outstanding problems that cannot be corrected by the balancing team or that will not be corrected by the installing trades (e.g. in cases where additional balancing dampers are required).

.13 Submit a statutory declaration to the Departmental Representative, certifying that the testing and balancing procedures have been completed, that complete factual reports have been distributed and that directions have been given to the Contractor to correct faults and omissions and, finally, that follow-up testing, after correction of faults and omissions, has been completed and recorded. Reports to be signed by the senior member of the TAB agency.

.14 Employ the testing and balancing agency to test all fire dampers as follows:

.1 Test all fire dampers. Test shall be made by releasing the fusible link and witnessing closure of the damper. All fire dampers shall be left in the open position.

.2 A set of prints shall be marked up to show that each damper has checked for closure, accessibility and installation or provide schematic mechanical drawing showing all fire damper locations, label all fire dampers on drawing and reference made in the completed test certificate submitted to the Departmental Representative.

.15 The Balancing Agency shall include for 5 (five) days of return visits for readjustment of systems after the building is occupied and used.

1.21 LIQUID SYSTEMS TAB

.1 Test and balance existing and new hot water boilers and the primary loop and secondary loop heating system flows and temperature control.

.2 The hot water heating will connect to existing hot water piping. In order to ensure that the specified flows are achieved at the new equipment, some rebalancing will be required of the existing balance valves and circulation pumps.

.1 Prior to start of balancing, meet with Departmental Representative to review existing hot water heating system.

.2 Measure and record the existing conditions, flows at all major branches and at existing terminal units and coils.

.3 Adjust settings of existing balance valves, in order to provide flow for new coils.

.4 After the specified flows are achieved in the new areas, measure, adjust and record the flows in the existing areas, to maintain the same values present before the Work commenced.

.5 Set balance valves and balance fittings to provide required or design flow rates for each system component.

.3 Use installed flow measuring devices to determine flow rates for system balance. Where flow measuring devices are not installed, base flow balance on the air and liquid temperature difference across terminal heating/cooling elements and coils, acknowledging the different design temperature drops/rises used in the design of the systems.

.4 Effect system balance with automatic control valves fully open to heat transfer elements.

.5 Check air vents to ensure that they are correctly installed and are operating properly. The mechanical contractor shall ensure that all air is removed from within the piping system and that there is flow throughout all piping systems before the balancing is started.

.6 Include in the liquid balance report:

.1 Existing and New Hot Water Heating Pumps:

.1 Include existing hot water flows at pumps and new flows after modifications.

.2 Design Data:

.1 Fluid flow rate.

.2 Total head.

.3 kW, r/min, amps, volts, phase.

.3 Installation Data:

.1 Manufacturer and model.

.2 Size.

.3 Type drive.

.4 Motor type, kW, r/min, voltage, phase, and full amperage.

.4 Recorded Data:

.1 Discharge and suction pressures (full flow and no flow).

.2 Operating head.

.3 Operating water flow rate (from pump curves if metering not provided).

.4 Motor operating amps (full flow and no flow).

.5 R/min.

.7 Heating Equipment: Boilers

.1 Design Data:

.1 Heat transfer rate.

.2 Fluid flow rate.

.3 Entering and leaving fluid temperatures.

.4 Fluid pressure drop.

.2 Installation Data:

.1 Manufacturer, model, type.

.2 Entering and leaving fluid temperatures.

.3 Capacity.

.4 Pressure drops.

.5 Flow rates.

.3 Recorded Data:

.1 Element type and identification (location and designation).

.2 Entering and leaving fluid temp (for varying outdoor temperatures).

.3 Fluid pressure drop.

.4 Fluid flow rate.

.5 Pressure relief valve setting.

1.22 POST-OCCUPANCY TAB

.1 Participate in systems checks twice during Warranty Period - #1 approximately three months after acceptance and #2 within one month of termination of Warranty Period.

.2 Include for two days on site for checking and system balance modifications during each visit.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Thermal insulation for equipment and equipment accessories.

1.2 RELATED SECTIONS

.1 Section 22 05 00 - Common Work Results for Plumbing

.2 Section 23 07 15 - Thermal Insulation for Piping

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials (ASTM International)

.1 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.2 ASTM C411-05, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.3 ASTM C547-07e1, Specification for Mineral Fiber Pipe Insulation.

.4 ASTM C553-08, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.5 ASTM C612-10, Specification for Mineral Fiber Block and Board Thermal Insulation.

.6 ASTM C921-10, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Thermal Insulation Association of Canada (TIAC)

.1 National Insulation Standards 2005.

.4 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Surface Burning Characteristics of Building Materials and Assemblies.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Project Interactive Electronic Operating and Maintenance and Commissioning Manuals.

.3 Submit shop drawings for equipment insulation. Include the following:

.1 Equipment insulation: manufacturer's catalogue literature.

.2 Installation requirements.

.3 Insulation finishes, indicating where each finish type will be applied.

.4 Quality Control Check Sheets.

.5 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 – Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet.

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Equipment insulation materials.

.2 Insulation thicknesses.

.3 Fire spread rating.

.4 Finishes – waterproof, where required.

.5 Equipment Identification.

.6 No exposed fibreglass edges.

.5 For each tabulated item, identify any areas of non compliance and the proposed action to make it compliant.

1.6 QUALIFICATIONS

.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

.3 Store at temperatures and conditions recommended by manufacturer.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: includes glass fibre, rock wool, slag wool.

.1 Recycled content: Post-Consumer + 1/2 Post-Industrial.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24^{o}C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Maximum "k" factor: ASTM C547.

.4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Jacket: to CGSB 1-GP-52Ma.

.3 Maximum "k" factor: ASTM C547.

.5 TIAC Code C-2: Mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: ASTM C553.

2.3 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: Compatible with insulation.

2.4 INSULATION SECUREMENTS

.1 Tape: Self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: Quick setting.

.1 Maximum VOC limit 80 g/L to SCAQMD Rule 1168 and GSES GS-36.

.3 Canvas adhesive: Washable.

.1 Maximum VOC limit 80 g/L to SCAQMD Rule 1168 and GSES GS-36.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

.6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation.

.7 Fasteners: 4 mm diameter pins with 35 mm diameter square clips. Length of pin to suit thickness of insulation.

2.5 REMOVABLE INSULATION COVERS

.1 Flexible mineral fibre or fibre glass fully enclosed on all sides and edges silicone fibre glass cloth suitable for temperatures involved with stainless steel wire mesh against hot surface.

.2 Insulation covers to be laced in place with brass/stainless steel hooks and copper/stainless steel wire and be easily removable.

2.6 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

.1 Maximum VOC limit 80 g/L to SCAQMD Rule 1168 and GSES GS-36.

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER MASTIC

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

Part 3 Execution

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE- INSTALLATION REQUIREMENTS

.1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards

- .1 Hot equipment: To TIAC code 1503-H.
- .2 Cold equipment: to TIAC code 1503-C.

.2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.

.3 Provide vapour retarder as recommended by manufacturer.

.4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

.5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

- .1 Hangers, supports outside vapour retarder jacket.

.7 Supports, Hangers:

- .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: At cold and hot expansion valves, valves, flanges, fittings, unions and other mechanical equipment that requires insulation but also requires periodic inspection.

.2 Installation to permit movement of expansion joint and equipment and to permit periodic removal and replacement without damage to adjacent insulation.

3.5 EQUIPMENT INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 Hot Equipment:

.1 TIAC code A-1 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.

.2 Thicknesses:

.1 Hot water heating valves and components that require maintenance: thickness to match piping.

.3 Cold equipment:

.1 TIAC A-3 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.

.2 TIAC C-2 faced with vapour retardant jacket and with wire or bands and 13 mm cement preceded by one layer of reinforcing mesh.

.3 Thicknesses:

.1 Domestic/fire/process water cold water valves and fittings: 50 mm.

.4 Finishes:

.1 Finish all insulation with canvas, except where provided with removable enclosure.

3.6 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Thermal insulation for mechanical and plumbing piping.

1.2 RELATED SECTIONS

.1 Section 07 84 00 - Fire Stopping

.2 Section 22 05 00 - Common Work Results for Plumbing

.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-2010; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM B209-07, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).

.2 ASTM C335-M-10, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-05, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-07e1, Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-08, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-10, Specification for Mineral Fiber Block and Board Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

.6 Insulation thickness and insulating values shall be in accordance with NRC Model National Energy Code of Canada for Buildings (MNECB).

1.4 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein, and including boiler room.

1.5 SUBMITTALS

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

.2 Submit shop drawings for duct insulation. Include the following:

.1 Pipe insulation: manufacturer's catalogue literature.

.2 Installation requirements.

.3 Pipe insulation finishes, indicating where each finish type will be applied.

.3 Insulation samples (Clause 1.6).

.4 Quality Control Check Sheets.

.5 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 SAMPLES

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

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.7 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 - Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet.

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Pipe insulation materials.

.2 Insulation thicknesses.

.3 Fire spread rating.

.4 Finishes – waterproof, where required.

.5 Identification.

.6 No exposed fibreglass edges.

.5 For each tabulated item, identify any areas of non compliance and the proposed action to make it compliant.

1.8 QUALIFICATIONS

.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 Insulation, all finishes and jackets shall be in accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified, includes glass fibre, rock wool, slag wool.

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24^{o}C mean temperature when tested in accordance with ASTM C335.

.3 High density insulation: 64 kg/m^3 density insulation.

2.3 PREFORMED PIPE COVERING

.1 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Maximum "k" factor: to CAN/ULC-S702.

.3 Thermal conductivity at 24^{o}C - 0.037 W/m/deg.C.

.4 Provide finish as described in Clause 3.11.

.2 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

.4 Thermal conductivity at 24^{o}C - 0.037 W/m/deg.C.

.5 Provide finish as described in Clause 3.11.

.3 TIAC Code A-6: flexible unicellular tubular elastomer.

.1 Insulation: with vapour retarder jacket.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

.4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

.5 Provide finish as described in Clause 3.11.

2.4 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.5 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting or Air drying on mineral wool, to ASTM C449/C449M.

2.6 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: Compatible with insulation.

.3 PVC White Finishing Jacket (minimum 0.50 mm thick):

.1 Proto PVC, Speedline PVC, Zeston PVC.

.4 Aluminum:

.1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco embossed.

.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.9 ACCESSORIES

.1 Vapour retarder lap adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 Tape: self-adhesive, aluminum, 50 mm wide minimum.

.5 Contact adhesive: quick-setting.

.6 Seal Coating:

.1 White washable, abrasion-resistant indoor fabric insulation coating, designed to resist mold and mildew growth. Lasting finish that does not yellow.

.7 Canvas adhesive: washable.

.8 Tie wire: 1.5 mm stainless steel.

.9 Banding: 12 mm wide, 0.5 mm thick stainless steel.

2.10 REMOVABLE INSULATION COVERS

.1 Flexible mineral fibre or fibre glass fully enclosed on all sides and edges silicone fibre glass cloth suitable for temperatures involved with stainless steel wire mesh against hot surface.

.2 Insulation covers to be laced in place with brass/stainless steel hooks and copper/stainless steel wire and be easily removable.

2.11 PREFORMED FITTING COVERS:

.1 PVC Fitting Covers:

.1 0.50 mm thick premoulded one piece covers with specified fire and smoke ratings.

Part 3 Execution

3.1 APPLICATION

.1 Pipe wrap – assured thermal performance

.1 Install in accordance with manufacturer's written instructions to provide stated thermal performance. This is achieved by determining the "stretch-out" cutting dimension required so that, once installed, the pipe wrap is not compressed to 75% of nominal thickness.

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure testing of piping systems to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and as indicated.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Apply insulation to piping only after all tests have been made and systems accepted by Departmental Representative.

.5 Apply insulation and insulation finish in a workmanlike manner so that the finished product is uniform in diameter, smooth in finish, pleasing to the eye and with the longitudinal seams positioned to be concealed from view. Apply piping insulation materials, accessories and finishes in accordance with manufacturer's recommendations.

.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.7 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

.8 On piping NPS 2-1/2 and larger with insulation and vapour barrier, install high density insulation above hanger shield. Insert to be slightly longer than the length of shield. Maintain integrity of vapour barrier over full length of pipe without interruption at sleeves, fittings and supports.

.9 Insulation and vapour barrier shall be continuous through all non-rated separations.

.10 Be responsible for insulation of all new work, as well as the repair of the insulation damaged by the work.

3.4 INSULATION TERMINATION POINTS

.1 Terminate insulation 75 mm back from all uninsulated fittings to provide working clearance and terminate insulation at 90^{o} and finish with reinforced scrim cloth and vapour barrier mastic system. Cover onto pipe and over the insulation vapour barrier. On concealed hot services terminate insulation 75mm back from all uninsulated fittings, cut off at 90^{o} and apply reinforced scrim cloth and breather mastic system.

.2 Cut back insulation at 45^{o} and finish with a silicone caulking sealant around the base of thermometer wells, pressure gauges, flow switches and pressure and control sensors.

.1 Hangers, supports to be outside vapour retarder jacket.

.3 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for Mechanical Piping and Equipment.

.4 Apply high compressive strength insulation where insulation may be compressed by weight of piping.

.5 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.5 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, primary flow measuring elements, flanges and unions at equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: high temperature fabric.

3.6 VERTICAL RISERS

.1 On vertical pipe over 75 mm provide insulation supports welded or bolted to pipe, directly above lowest pipe fitting. Thereafter, locate on 4.5 m centres.

3.7 HOT APPLICATION 26.7°C AND OVER

.1 Piping:

.1 Install medium temperature pipe insulation with integral jacket to pipe and hold in place by stapling the flap, with spreading staples at 75 mm centres. Pipe insulation with integral self-sealing jacket will not require additional fastening.

.2 Install strips of vapour barrier jacket over butt joints and secure with spreading staples.

.2 Fittings:

.1 Insulate fittings, to thickness of adjacent pipe insulation, with sections of the pipe insulation mitred to fit tightly, or with preformed insulation fittings or from insulation fabricator.

.3 Valves, Strainers:

.1 Insulate valve bodies and strainers with fitted pipe insulation, or mitred blocks all to thickness of adjacent pipe insulation or insulate with preformed insulation fittings or from insulation fabricator. Drains, blowoff plugs and caps shall be left uncovered.

.4 Flanges and Victaulic Fittings:

.1 Insulate flanges with oversized pipe insulation or mitred blocks to the thickness of the adjacent pipe insulation. Insulation to overlap adjoining insulation at least 75 mm.

3.8 COLD APPLICATION 10°C AND LESS

.1 Piping:

.1 Install low/medium temperature pipe insulation with integral vapour barrier jacket to pipe and hold in place by securing the jacket flap. Seal all flaps with vapour barrier adhesive. Pipe insulation with integral self-sealing vapour barrier jackets will not require additional fastening.

.2 Install strips of vapour barrier jacket over butt joints with vapour barrier adhesive. Over wrap butt strips by 50 percent for insulation O.D. 300 mm and above apply strips on 250 mm centres for additional securement.

.2 Fittings:

.1 Insulate fittings to thickness of adjacent pipe insulation with sections of the pipe insulation mitred to fit tightly, or preformed insulation fittings, then apply reinforcing membrane embedded barrier coating and apply finish vapour barrier coating.

.2 Alternatively insulate fittings with tightly placed flexible insulation and apply premoulded 25/50 rated PVC fitting covers. Apply vapour-barrier adhesive and tape on all joints and overlaps.

.3 Valves, Strainers:

.1 Insulate valve bodies, bonnets and strainers with fitted pipe insulation, or mitred blocks all to thickness of adjacent pipe insulation, then apply reinforcing membrane embedded in barrier coating. Alternately, insulate with preformed insulation fittings covered with reinforcing membrane, stapled in place and covered with a barrier coating. Drains, blow-off plugs and caps shall be left uncovered.

.4 Unions, Flange and Victaulic Fittings:

.1 Insulate cold unions and flanges with oversized pipe insulation or mitred blocks to the thickness of the adjacent pipe covering, then apply reinforcing membrane embedded in barrier coating and final coating of vapour barrier mastic.

3.9 ANTI-SWEAT COATING

.1 Coat the following uninsulated cold surfaces with an anti-sweat coating:

.1 Connecting surfaces of thermometers, pressure gauges, flow switches, controllers, etc.

.2 The coating thickness shall be as recommended by the coating manufacturer for the system operation conditions.

3.10 SCOPE OF INSULATION

.1 Heating Pipe, Fittings and Valves:

.1 Insulate the following systems, unless otherwise noted:

.1 Hot water heating supply and return piping.

.2 Refrigerant hot gas piping.

.2 DO NOT insulate the following, unless otherwise noted:

.1 Piping located within perimeter heating enclosures.

.2 Relief piping.

.3 Drain lines.

.3 Insulate the following valves and fittings if the pipe is insulated:

.1 Elbows, tees, reducers.

.2 Valve bodies on valves and check valves, over NPS 2-1/2.

.3 Flanges.

.4 Strainers.

.4 The following hot pipe fittings that operate at 60^{o} C and over shall be coated with insulating coating as per manufacturer's specifications to prevent skin burns:

.1 Valves, NPS 2-1/2" and smaller.

.2 Valve bonnets.

.3 Unions.

.4 Flexible connections.

.5 Expansion joints.

.6 Check valve covers.

.2 Plumbing pipes, fire protection pipes, fittings, valves:

.1 Insulate the following systems, unless otherwise noted:

.1 Domestic cold water system including meter body and including traps on handicapped lavatories.

.2 Domestic hot water supply and recirculation piping.

.3 Process water piping.

.4 Existing vertical rainwater leaders and cast iron fittings from existing horizontal drain insulation at high level to the penetration of the main floor slab.

.5 Water valves, flanges, PRV's, backflow preventers, strainers, check valves.

.2 DO NOT insulate the following, unless otherwise noted:

.1 Piping used exclusively for fire protection.

.2 Soil stacks, vents, etc.

.3 All special service piping, e.g. gas, compressed air, etc.

.4 Unions.

.5 Flexible connections or expansion joints (unless noted on the drawings).

.6 Check valve covers.

.7 Strainer leg and basket covers.

.8 Flexible fixture connections.

.3 Pipe penetrations through walls and floors:

.1 All material for the stuffing, sealing and caulking of the pipe penetration shall be supplied and installed under this section.

3.11 PIPING INSULATION SCHEDULES

.1 Includes piping, valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: SS bands at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H. Finish as per Clause 3.11.

.3 TIAC Code: A-3.

.1 Securements: SS bands at 300 mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C. Finish as per Clause 3.11.

.4 Thickness of insulation as listed in following table.

			PIPE INSULATION THICKNESS (MM)				
Service	**Design Operating Temperature**	**TIAC CODE**	**NOMINAL PIPE OR RUBE SIZE (NPS)**				
			< 1	**1 to < 1½**	**1½ to < 4**	**4 to < 8**	**≥ 8**
Hot Water Heating/Heat Pump Supply and Return	50-90°C	A-1	40	40	50	50	50
Domestic Cold Water	5°C	A-3	25	25	25	25	25
Domestic Hot Water Supply and Recirculation	40-70°C	A-3	40	40	50	50	50
Above Grade Interior Rainwater Storm Drainage	5°C	A-3	25	25	25	25	25
Refrigerant Piping (suction and hot gas)	-	A-6	25	25	25	25	25
P-traps off roof cooling units		A-3	25	25	25	25	25

3.12 PIPE INSULATION FINISHES

.1 "Concealed" insulation in horizontal and vertical service spaces, including within ceiling spaces will require no further finish.

.2 "Exposed" insulation inside all areas (including Level 0 crawlspace) shall be finished as follows:

.1 Over a factory applied integral all-service type jacket on the pipe insulation, apply canvas jacket, complete with seal coating. Finish fabric with one coat of fabric coating that meets specified flame spread and smoke development rating.

.2 Provide removable insulating jackets on all large serviceable equipment/devices. Where valves, etc., are too small for jackets, apply canvas jacket on valve bodies and all pipe fittings, Finish fabric with one coat of fabric coating that meets specified flame spread and smoke development rating. Alternate over insulated fittings apply PVC fitting covers. Over insulated valve bodies, valve bonnets, strainers and flanges apply prefabricated PVC covers, or neatly fabricate from PVC sheeting secured with solvent bonding cement.

.3 Finish attachments: SS bands, at 150 mm on centre.

.4 Installation: to appropriate TIAC code CRF/1 through CPF/5.

.5 Provide water tight aluminum jacket for all exposed refrigerant and cold water piping on roof.

3.13 FIRE STOPPING AND SMOKE SEALS

.1 Fire stopping shall be done under Section 07 84 00 - Fire Stopping.

.2 Maintain insulation around pipes penetrating fire separation only as permitted by Firestop Assembly Listing.

3.14 INSULATION PACKING OF PIPE SLEEVES

.1 Tightly pack the space between all pipe sleeves and pipe or between pipe sleeve and pipe insulation with mineral wool insulation, to full depth of sleeve to prevent transmission of sound and/or passage of smoke.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Commissioning requirements for mechanical equipment and systems.

.2 Coordinate the Work in this section with Section 01 91 13 – Commissioning Requirements.

1.2 ACRONYMS

.1 BAS – Building Automation System

.2 CxA – Commissioning Authority

.3 Cx – Commissioning

.4 DCAE – Directorate of Corporate Architecture and Engineering

.5 EMCS – Energy Management and Control System

.6 CM - Construction Manager

.7 O&M – Operation and Maintenance

.8 TAB – Testing, Adjusting, and Balancing

1.3 DEFINITIONS

.1 **Commissioning (aka Commissioning Process)** — a systematic verification, documentation and training process applied to all activities during construction, installation/start-up or pre functional static verification, start up and functional performance testing, of equipment and systems in a facility to ensure that the facility operates in conformity with the Departmental Representative's project requirements and the basis of design in accordance with the contract documents.

.2 **Commissioning Authority** — an independent commissioning agency, company or an individual appointed by the Construction Manager and not affiliated with mechanical and electrical Trade Contractors of this project, to plan, lead and coordinate the commissioning team to implement the commissioning process. The commissioning authority is also responsible for producing commissioning report.

.3 **Commissioning Check Sheets** — the forms used to document the inspections, tests, etc. performed during the commissioning process prepared by Trade Contractors and sub-Trade Contractors. Commissioning check sheets include 'Installation/Start-up Checklists' or 'Pre-functional Checklists', 'Performance Verification Forms' or 'Functional/Dynamic Forms', functional testing procedures and any other forms and check sheets specified in other sections.

.4 **Commissioning Team -** The individuals who through coordinated actions are responsible for implementing the Commissioning Process. Includes Commissioning Authority, Construction Manager or representative, Trade Contractors, sub-Trade Contractors, Commissioning Authority, Departmental Representative and Design Consultant.

.5 **Consultant or Design Consultant** — an organization involved in the planning and design process and who provides specialized resources and skills.

.6 **Construction Manager** — an individual or company that enters into a contract with the Departmental Representative to provide construction management services on the project. Trade Contractors are contracted to the Construction Manager to perform specific scopes of Work.

.7 **Control system** — a local system (EMCS and/or PLC) that controls the operation of a stand-alone mechanical system or mechanical equipment or integrated control of the entire building system. A control system comprises controlled devices (e.g., valves), controlling devices (e.g., thermostats), control wiring, and power supply.

.8 **Design intent** — the performance that a design is intended to achieve in order to meet the operational requirements and basis of design. The design intent is recorded in a design intent manual and guides the preparation of the contract documents. The design intent documentation should cover the following, for each system, major component, facility and area:

.1 General system description
.2 Objectives and functional use of the system, equipment or facility
.3 General quality of materials and construction
.4 Occupancy requirements
.5 Indoor environmental quality, IEQ (space temperature, relative humidity, indoor air quality, noise level, illumination level, etc.)
.6 Performance criteria (general efficiency, energy and tolerances of the IEQ objectives, etc.)
.7 Budget and considerations and limitations
.8 Restrictions and limitations of system or facility

.9 **Electrical Commissioning Coordinator -** an independent individual or company engaged by the Electrical Trade Contractor responsible for planning, and carrying out commissioning of electrical equipment and systems, responsible for participating in the commissioning process and preparing installation/start up or pre-functional checklists and performance verification or functional/dynamic forms.

.10 **Inspection** - a service traditionally provided as part of the normal scope of a consultant's work. Inspection includes a review of building systems and equipment, or parts thereof.

.11 **Integration** - Making diverse components and building systems work together under all potential operating conditions

.12 **Mechanical Commissioning Coordinator –** an independent individual or company engaged by the Mechanical Trade Contractor responsible for planning, and carrying out commissioning of mechanical equipment and systems, responsible for participating in the commissioning process and preparing installation/start up or pre-functional checklists and performance verification or functional/dynamic forms.

.13 **Mock up** – A model, either full size or to scale, of a construction system or assembly used to analyze construction details, strength, appearance, functionality and performance. It can be built on site as part of the finished work or in a shop environment.

.14 **Operations and Maintenance manual** — a detailed document that provides the operating and maintenance requirements and associated data for the safe and efficient operation of specific pieces of equipment and systems.

.15 **Optimization** — adjusting the building systems to run smoothly and operate in the most effective and efficient condition when a facility is being used as intended.

.16 **Departmental Representative** – the entity that represents the interests of the facility.

.17 **Performance Verification or Functional Performance Testing** – a full range of tests under actual load, conducted to verify specific systems, subsystems, components, and interfaces between systems that conform to a given criteria. These tests are typically used to verify that a sequence of operations is correctly implemented and that the design intent has been met. They are typically done after equipment is placed in full operation.

.18 **Testing agency** — a regulatory authority or other agency, individual, or contractor authorized and/or charged by a facility Departmental Representative, consultant, Trade Contractor or sub-Trade Contractor with the responsibility for carrying out Performance Verification or Functional Performance testing and/or verification of building systems and equipment, or parts thereof.

.19 **Test Procedure -** A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems. This documentation required by the construction Trade Contractor or sub-Trade Contractor responsible for testing of supplied and installed equipment as per the commissioning plan and specification. Testing procedures are developed by the and mechanical and electrical Trade Contractors.

.20 **Validate -** For start-up and performance testing: to witness and confirm proper and complete performance testing and record all deficiencies and report to Construction Manager, Departmental Representative and design consultant; when the instructed corrections have been completed re-validate all the deficiencies; and to provide full and detailed documentation for the Consultant certification.

.21 **Verify -** The CxA's witnessing of the specified performance tests. The Construction Manager shall attend all verifications, and record all deficiencies to be handed out to the CxA for inclusion in final Cx report.

1.4 SUBMITTALS

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

.2 Develop and submit Installation/Start Up or Pre-functional Checklists, Performance Verification or Functional/Dynamic Forms and Performance Verification or Functional Test Procedures for all mechanical equipment and systems in PDF electronic format.

.3 Closeout Submittals:

.1 Submit completed and signed forms, checklists and test results after completion of commissioning for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals and Section 01 91 13 – Commissioning Requirements.

1.5 QUALITY ASSURANCE

.1 The commissioning shall be executed in accordance with CSA Building Commissioning Z320-11.

1.6 GENERAL

.1 Be responsible for the performance and commissioning of all equipment supplied under Sections of Division 21, 22, 23, and 25.

.2 Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.

.3 In consultation with the Construction Manager, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.

1.7 MECHANICAL COMMISSIONING COORDINATOR

.1 Retain services of independent Mechanical Commissioning Coordinator with demonstrated minimum 10 years of experience in commissioning of mechanical systems and equipment such as those required on this project.

.2 This coordinator will be responsible for participation in commissioning process and providing required mechanical commissioning services specified in the contract documents.

.3 Mechanical Commissioning Coordinator will be responsible for developing Installation/Start Up or Pre-functional Checklists, Performance Verification or Functional/Dynamic Forms and Performance Verification or Functional Test Procedures.

.4 Mechanical Commissioning Coordinator to be an independent company or individual.

1.8 RESPONSIBILITIES

.1 The commissioning responsibilities applicable to each of the Trade Contractors, sub-Trade Contractors, suppliers, mechanical commissioning coordinator and other affected parties of the Divisions 21, 22, 23 and 25 are as follows (all references apply to commissioned equipment and systems only):

Construction and Acceptance Phases

.1 Include and itemize the cost of commissioning in the contract price.

.2 In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.

.3 Attend a commissioning scoping meeting and other meetings necessary to facilitate the Cx process.

.4 Trade Contractors shall provide the CxA with normal cut sheets and shop drawing submittals of commissioned equipment in digital media.

.5 Provide additional requested documentation, prior to normal O&M manual submittals:

a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any Departmental Representative-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Departmental Representative to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.

b. The CxA may request further documentation necessary for the commissioning process.

c. This data request may be made prior to normal submittals.

.6 Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CxA for review and approval.

.7 Trade Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient.

.8 Prepare and provide to the CxA commissioning forms including Installation/Start Up or Pre-functional Checklists, Performance Verification or Functional/Dynamic Forms and Performance Verification or Functional Performance Test Procedures as specified. Trade Contractors shall develop test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

.9 Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the verification/static forms and prefunctional checklists for all commissioned equipment and systems. Submit to CxA for review and approval prior to startup. Refer to Section 01 91 13 – Commissioning Requirements for further details on start-up plan preparation.

.10 During the startup and initial checkout process, execute Installation/Start Up or Pre-functional Checklists for all commissioned equipment and systems for the work covered under the above listed Divisions.

.11 Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

.12 Address current deficiencies before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.

.13 Provide skilled technicians to execute Performance Verification or Functional/Dynamic Forms and the Performance Verification or functional performance tests and starting of equipment. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

.14 Provide skilled technicians to perform functional performance testing under the direction of the CxA for specified equipment and systems in respective sections and Section 01 91 13 – Commissioning Requirements. Assist the CxA in interpreting the monitoring data, as necessary.

.15 Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, Construction Manager, Departmental Representative and Design Consultant and retest the equipment.

.16 Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

.17 During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for Construction Manager generated coordination drawings. Update after completion of commissioning (excluding deferred testing).

.18 Provide training of the Departmental Representative's operating staff using expert qualified personnel, as specified.

.19 Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

.20 Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

.21 Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

.2 Mechanical Requirements. The responsibilities of the mechanical Trade Contractor, during construction and acceptance phases in addition to those listed in (.1) are:

.1 Provide startup for all equipment, except for the building automation control system.

.2 Assist and cooperate with the TAB sub-Trade Contractor and CxA by:

a. Putting all mechanical and process equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.

b. Including cost of sheaves and belts that may be required for final balance by TAB.

c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.

d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

.3 Provide a Pressure/Temperature (P/T) plug at each water sensor which is an input point to the control system.

.4 List and clearly identify on the as-built drawings the locations of all air-flow stations.

.5 Prepare a preliminary schedule for pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CxA. Update the schedule as appropriate.

.6 Notify the Construction Manager or CxA depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the Construction Manager or CxA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

.3 Controls Requirements – EMCS. The commissioning responsibilities of the sub-Trade Contractor are described in Division 25.

.4 TAB Requirements. The duties of the TAB sub-Trade Contractor are listed in Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

1.9 COMMISSIONING AND DEMONSTRATION

.1 Provide the services of an approved independent specialist firm or individual to coordinate the commissioning process specified under this division and those items of other Divisions which interact with work of this Division as outlined herein, including the complete life safety and fire protection systems.

.2 Coordinate work with commissioning specified in Division 1.

.3 The cooperation of all trades is essential for an efficient and planned process. A team comprising the following is recommended:

.1 Mechanical Commissioning Coordinator.

.2 Construction Manager

.3 Mechanical Trade Contractor's Supervisor.

.4 Division 23 and 25 Trades.

.5 Division 26.

.4 Prepare a commissioning statement for each of the four (4) phases that the process is perceived to be worked through. In sequence, the phases are expected to be:

.1 PHASE 1 - System readiness.

.2 PHASE 2 - System start-up, testing, balancing etc.

.3 PHASE 3 - Verification of system performance.

.4 PHASE 4 - Demonstration & instruction.

.5 Each phase is applicable to each major and/or separate system making up the work in Divisions 21, 22, 23 and 25 plus interface with Division 26, as applicable.

.6 Regular meetings shall be held during the commissioning process. Minutes of the meetings shall be issued by the CxA to the Construction Manager, all Trade Contractors and sub-Trade Contractors involved and Departmental Representative.

.7 Plan the work to be specific in respect of personnel, schedule, review and laboratory tests.

.1 Personnel: Assign direct overall charge of commissioning to a person (the mechanical commissioning coordinator) fully qualified through practical experience and a comprehensive knowledge of the interactive nature of building and process systems and their controls to understand the complete system and be available to carry the project through to total completion. This person shall be responsible for: Commissioning, Demonstration to the CxA, Construction Manager and Departmental Representative and Certifications of Substantial and Total Performance.

.2 Schedule: Submit information to the Construction Manager to develop a schedule for the commissioning phase of the work. Provide the following information:

.1 Equipment start-up schedule.

.2 Submission dates for the various documents required prior to substantial performance.

.3 Timing of the various phases of the commissioning, testing, balancing and demonstration process.

.3 Within two (2) months of commencing with the project work, the person having direct overall charge of commissioning shall review design intent and intended commissioning procedures with the CxA, Construction Manager and Consultant. Within three (3) months of commencing with the project, submit a detailed plan that addresses the entire approach to the commissioning process. The plan shall be prepared specifically for the project at hand. The plan shall include the following components:

.1 Name and qualifications of the commissioning coordinator.

.2 Itemized check lists for the readiness, start-up and operational verification of all equipment and systems.

.3 Outline of proposed method of notification and correction of interim operational deficiencies.

.4 Outline of proposed demonstration and operator training program.

.4 Troubleshooting: Where problems become apparent during the commissioning process, work at the identification and resolution of these problems. The basic functions in trouble shooting are:

.1 What - Identification and definition of the problem.

.2 Why - Determination and evaluation of the causes.

.3 When - Determine the time available to resolve the problem.

.4 Involve the Construction Manager in the review of the problem and proposed resolution.

.5 Coordinate remedial action with the appropriate parties.

.6 Evaluate the effectiveness of the remedial action.

.5 Laboratory Tests: If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Construction Manager. In the event that equipment does not meet specifications, Trade Contractor shall be responsible for the costs of:

.1 The above laboratory tests, and

.2 All subsequent testing and correction required.

.8 The work included in each of the four phases shall be generally as follows:

.1 PHASE 1 System readiness

.1 Before starting any of the separate systems, provide a certificate stating that the specific system is ready for start-up and the following conditions have been met.

.1 All safety controls installed and fully operational (dry run test).

.2 Qualified personnel available to operate the plant.

.3 Permanent electrical connections made to all equipment.

.2 System readiness shall include, but not necessarily be limited to the following:

.1 Checking system physical completion, including all instrumentation.

.2 Flushing, chemical cleaning (as required), charging, fluid treating (as required).

.3 Equipment lubrication and prestart checks.

.4 Rotational checks.

.5 Air system cleaning complete.

.6 All cooling direct expansion (D.X.) systems checked for pressure and leakage.

.7 Filter systems installed and sealed in place.

.8 Adjusting vibration isolation and seismic restraints.

.9 Alignment of drives (direct and belt).

.10 Control function checks, including all alarms.

.11 Self diagnostic packaged control items checked.

.12 Seismic SRS system for all equipment, as applicable

.13 All deficiencies to be recorded, reviewed by the commissioning team and, subsequently, corrected before proceeding to PHASE 2.

.14 Copies of all test and certificates (site testing reports, manufacturer's production test records) have been submitted to the Construction Manager.

.2 PHASE 2 System startup, testing, balancing

.1 System commissioning shall include, but not necessarily be limited to:

.1 Activation of all equipment and systems.

.2 Testing and adjustment of all equipment and systems.

.3 Activation, testing and adjustment of existing equipment.

.4 All deficiencies are to be recorded, reviewed by the commissioning team and, subsequently, corrected. The process at the point of the deficiency, shall be repeated before proceeding to PHASE 3.

.2 Phase 2 is concluded when the installation is in full working order and acceptable for use. The work will include the following:

.1 Balancing of existing and new liquid systems.

.2 Set up all automatic control valves and automatic temperature control devices.

.3 Adjust vibration isolators and seismic restraints as necessary.

.4 Verification and certification of the sealing of all pipe penetrations through fire separations (rated & non-rated) and other separations.

.5 Verification of water tightness of all roof and exterior wall penetrations.

.6 Verification that all coil drain pans operate.

.7 Testing and debugging of EMCS (Energy Management Control System), in conjunction with Division 25 tests and commissioning.

.8 Set up and test all alarm protective devices.

.9 Set up and test compressed air and breathing air systems.

.3 Fine Tuning

.1 Setting up automatic controls for accurate response and precise sequencing.

.2 Correction of problems revealed by Balance Agency.

.4 Testing

.1 A detailed check by a person having direct overall charge of commissioning. This check to include all items and functions to be later demonstrated to the CxA, Construction Manager and Departmental Representatives.

.3 PHASE 3 Verification of System Performance

.1 Verification of system performance by the CxA will not commence until PHASE 2 has been totally completed. Submit test procedure completion test certificates at the time of requesting the commencement of the verification procedure. The verification process will include the demonstration of the following:

.1 The ease of access that has been provided throughout for servicing coils, motors, drives, fusible fire damper links, control dampers and damper operators.

.2 Location of and opening and closing of all access panels.

.3 Operation of all automatic temperature control devices.

.4 Proper response of all systems to temperature space sensors.

.5 Operation of all equipment and systems, under each mode of operation including but not limited to:

.6 E.M.C.S. control features and all automatic controls

.7 Coils

.8 Natural gas system for equipment

.9 Water Treatment (Hydronic heating system)

.10 Non EMCS mechanical controls

.2 At the completion of Phase 3, the Trade Contractor shall submit the following to the Construction Manager:

.1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.

.2 A commissioning report which should include completed copies of all Phase 2 documentation outlined in the commissioning plan plus copies of start-up reports from specialty contractors and vendors and any other relevant information for inclusion in the operating & maintenance manuals.

.3 Approval of boilers on gas firing, from certified BC registered gas fitter.

.4 Certificate from BC Safety Authority.

.5 Record drawings as specified, update to include changes resulting from commissioning.

.6 Identification of equipment and systems complete.

.4 PHASE 4 Demonstration and Acceptance

.1 Demonstration and acceptance shall not commence until the commissioning process PHASE 3 has been successfully completed.

.2 The Demonstration process is a planned process requiring a preplan approval before commencement and a signed statement of satisfaction from the CxA upon completion.

.3 For Demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to Section 01 79 00 -Demonstration and Training.

.5 Post Substantial Performance Visits

.1 Provide one follow-up visit to the site one month after occupancy and operation of systems a one day, to ensure that the systems are operating correctly and that they are being operated properly.

.2 Submit a report to the Construction Manager and Departmental Representative documenting any problems that have arisen and correction action required.

1.10 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification, for each upgrade phase, after cleaning is completed and system is in full operation.

.2 Scope of work includes:

.1 Hot water heating system

.3 When systems are operational, perform following tests:

.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 24 hours to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system, recording system pressures, temperatures, fluctuations by simulating maximum and varying design conditions.

.1 Operation of boilers and hot water heating pumps.

.2 Maximum heating demand.

.3 Verify existing hot water flows and capacities prior to any new work, so there is a reference starting point for the system capacity.

1.11 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests, for each upgrade phase, after:

.1 TAB has been completed

.2 Verification of flow rates at all terminal units.

.3 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost for test.

.3 Heating system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Reducing space temperature by turning off heating system for sufficient period of time before starting testing.

.2 Test procedures:

.1 Open fully heating coil control valves.

.2 With boilers at maximum output and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

1.12 NATURAL GAS SYSTEMS

.1 Perform operation tests, for each upgrade phase:

.1 Measure gas pressure at all air handling unit, boiler and domestic hot water heater burner manifolds.

.2 Check settings and operation of equipment pressure reducing valves.

.3 Check terminals of vents for gas pressure regulators.

1.13 INSTALLATION/START UP OR PRE-FUNCTIONAL CHECKLISTS

.1 Produce Installation/Start up or Pre-functional Checklists.

.2 The forms and checklists shall contain items for both Mechanical and Electrical Trade Contractors to perform. On each form and checklist, provide a column that should be filled out by the Construction Manager assigning responsibility for that line item to a trade. Those executing the forms and checklists are only responsible to perform items that apply to the specific application at hand. These forms and checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some forms and checklists procedures may be redundant of some checkout procedures that will be documented on typical factory field checkout sheets. Double documenting is required in those cases.

.3 Refer to Section 01 91 13 – Commissioning Requirements for requirements regarding installation/start up and pre-functional checklists, startup and initial checkout. Develop Installation/Start up or Pre-functional Checklists for each item, equipment and system.

.4 Trade Contractors assigned responsibility for sections of the form and checklist shall be responsible to see that form and checklist items by their sub-Trade Contractors are completed and checked off. "Contr." column or abbreviations in brackets to the right of an item refer to the Trade Contractor or sub-Trade Contractor responsible to verify completion of this item. All = Trade Contractors, CxA = commissioning authority, CC = controls sub-Trade Contractor (EMCS and Plant Control System (PCS)), DC = Design Consultant, EC = electrical Trade Contractor, CM = Construction Manager, MC = mechanical sub-Trade Contractor, SC = sheet metal sub-Trade Contractor, TAB = test and balance sub-Trade Contractor.

1.14 PHASED CONSTRUCTION

Develop Performance Verification or Functional/Dynamic Forms and Performance Verification or Functional Testing procedure and carry out functional testing as required.

Part 2 Products

2.1 TEST EQUIPMENT

.1 Trade Contractors, sub-Trade Contractors, suppliers, commissioning agencies and other affected parties of the Divisions 23 and 25 shall provide all test equipment necessary to fulfill the testing requirements as specified.

Part 3 Execution

3.1 SUBMITTALS

.1 Provide submittal documentation relative to commissioning as required in Part 1, Section 01 91 13 – Commissioning Requirements.

3.2 STARTUP

.1 The Trade Contractors, sub-Trade Contractors, suppliers, commissioning agency and other affected parties of Divisions 23 and 25 shall follow the start-up and initial checkout procedures listed in Clauses 1.8, 1.9 and in Section 01 91 13 – Commissioning Requirements. Responsibilities include start-up and complete systems and sub-systems that are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the CxA or the Construction Manager.

.2 Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and Departmental Representative. Beginning system testing before full completion, does not relieve the Trade Contractor from fully completing the system, including all Installation/Start up or pre-functional checklists as soon as possible.

3.3 TAB

.1 Coordinate commissioning with TAB.

.2 Refer to Section 23 05 93 – Testing, Adjusting and Balancing for HVAC for TAB scope of work.

3.4 INSTALLATION/START UP OR PREFUNCTIONAL CHECKLISTS

.1 Provide Installation/Start up or pre-functional checklists – include in maintenance manual.

3.5 OPERATION AND MAINTENANCE (O&M) MANUALS

.1 The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.

.2 Compile and prepare documentation for all equipment and systems covered in Divisions 21, 22, 23 and 25 and deliver this documentation to the Construction Manager for inclusion in the O&M Manuals, according to this section and individual technical sections, prior to the training of Departmental Representative personnel.

.3 The CxA shall receive a copy of the O&M manuals for review.

.4 Special Control System O&M Manual Requirements. In addition to documentation that may be specified elsewhere, the controls sub-Trade Contractor (s) shall compile and organize at minimum the following data on the control system in labeled 3-ring binders with indexed tabs.

.1 Three copies of the controls training manuals in a separate manual from the O&M Manuals.

.2 Operation and Maintenance Manuals containing:

a. Specific instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification

and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.

b. Full as-built set of control drawings (refer to Submittal section above for details).

c. Full as-built sequence of operations for each piece of equipment.

d. Full EMCS controls points list.

e. Full print out of all schedules and set points after testing and acceptance of the system.

f. Full as-built print out of software program.

g. Electronic copy on disk of the entire program for this facility.

h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

i. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.

j. Control equipment component submittals, parts lists, etc.

k. Warranty requirements.

l. Copies of all checkout tests and calibrations performed by the Trade Contractor.

.3 The manual shall be organized and subdivided with permanently labeled tabs for each of the following data in the given order:

a. Sequences of operation

b. Control drawings

c. Points lists

d. Controller / module data

e. Thermostats and timers

f. Sensors and DP switches

g. Valves and valve actuators

h. Dampers and damper actuators

i. Program setups (software program printouts)

.4 Field checkout sheets and trend logs should be provided to the CxA for inclusion in the Commissioning Record Book.

.5 Special TAB Documentation Requirements. The TAB will compile and submit the following with other documentation that may be specified elsewhere in the *Specifications*.

.1 Final report containing an explanation of the methodology, assumptions, test conditions and the results in a clear format with designations of all uncommon abbreviations and column headings.

.2 The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

.6 Review and Approvals. Review of the commissioning related sections of the O&M manuals shall be made by the Design Consultant and the CxA. Refer to Section 01 91 13 - Commissioning Requirements for details.

3.6 TRAINING OF PERSONNEL

.1 The Commissioning Agent shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. The Trade Contractor is responsible for the training plan and for engaging all trainers. Refer to Section 01 91 13 – Commissioning Requirements for additional details.

.2 The CxA shall be responsible for overseeing and approving the content and adequacy of the training of personnel for commissioned equipment and systems. Refer to Section 01 91 13 - Commissioning Requirements for additional details.

.3 Mechanical Systems and Equipment.

.1 Provide the CxA with a training plan two weeks before the planned training according to the outline described in Section 01 91 13 – Commissioning Requirements.

.2 Provide designated personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment and system including, but not limited to air handling units, fans, terminal units, controls, etc.

.3 Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including start-up, shutdown, fire/smoke alarm, power failure, etc.

.4 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

.5 The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.

.6 The controls sub-Trade Contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

.7 The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

.8 Training shall include:

a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.

b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

c. Discussion of relevant health and safety issues and concerns.

d. Discussion of warranties and guarantees.

e. Common troubleshooting problems and solutions.

f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.

g. Discussion of any peculiarities of equipment installation or operation.

h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.

.9 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.

.10 The mechanical Trade Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

.11 Training shall occur after functional testing is complete, unless approved otherwise by the Departmental Representative.

.12 Duration of Training. The mechanical trade contractor shall provide training on each piece of equipment and system according to the following schedule:

.3 Boilers and Pumps – 1 day

.4 Controls – 3 Days

.1 Controls Requirements

.1 Refer to requirements in Division 25.

.2 TAB

.1 TAB shall meet for one day with facility staff after completion of TAB and instruct them on the following:

a. Go over the final TAB report, explaining the layout and meanings of each data type.

b. Discuss any outstanding deficient items in control or design that may affect the proper delivery of air or water.

c. Identify and discuss any pumps that are close to or are not meeting their design capacity.

d. Other salient information that may be useful for facility operations, relative to TAB.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 RELATED SECTIONS

.1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

.2 Section 23 25 00 - HVAC Water Treatment Systems

1.3 SUBMITTALS

.1 Shop Drawings:

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

.2 Include product literature, specifications, product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

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 CLEANING HYDRONIC SYSTEMS

.1 Clean boilers and all piping and fittings installed in this contract.

.2 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.3 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers: clean prior to initial fill.

.6 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:

.1 Provide water treatment for complete system.

.2 Fill system with water, ensure air is vented from system.

.3 Use water meter to record volume of water in system.

.4 Add chemicals under direct supervision of chemical treatment supplier.

.5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.7 Add chemical solution to system.

.8 Establish circulation, raise temperature slowly to maximum design temperature. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite)?

.9 Verify that water in new piping is clean and free of debris, to satisfaction of Departmental Representative, prior to connection to existing hydronic system.

3.3 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning of existing and new piping is completed and system is filled:

.1 Ensure air is removed.

.2 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.

.3 Bring system up to design temperature and pressure slowly over a 48 hour period.

.4 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Adjust pipe supports and hangers as necessary.

.6 Monitor pipe movement, performance of expansion joints, loops, guides and anchors.

.7 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.8 Check operation of drain valves.

.9 Adjust valve stem packings as systems settle down.

.10 Fully open balancing valves (except those that are factory-set).

.11 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for piping, valves and fittings for natural gas fired process and HVAC equipment.

1.2 RELATED SECTIONS:

.1 Section 23 05 05 - Installation of Pipework

.2 Section 23 08 01 - Performance Verification – Mechanical Piping Systems

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.5-2009, Pipe Flanges and Flanged Fittings.
.2 ASME B16.18-01 (R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
.3 ASME B16.22-01 (R2010), Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
.4 ASME B18.2.1-96 (R2005), Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A47-2009, Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
.3 ASTM B75/B75M-11, Standard Specification for Seamless Copper Tube.
.4 ASTM B837-10, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA International)

.1 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

.1 CAN/CSA B149.1-10, Natural Gas and Propane Installation Code Handbook.

1.4 SUBMITTALS

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

.2 Shop Drawings:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Include the following shop drawings:

.1 Piping and fittings.

.2 Valves.

.3 Pressure regulating valves.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Quality Control Check Sheets.

.6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting one week prior to beginning work of this Section.

.1 Verify project requirements.

.2 Review installation conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 – Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Pipe material and specifications

.2 Pipe finish (corrosion protection, painted)

.3 Pipe support type and spacing

.4 Pipe support finish (corrosion protection, painted)

.5 Details of pipe attachment to structure

.6 Identification

.7 Access to valves

.8 Pressure and leak testing report

.9 Comments on seismic installation

.10 Maintenance instructions

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 PIPE (ABOVE GROUND)

.1 Steel pipe: to ASTM A53/A53M or ASTM A106, Schedule 40, seamless as follows

.1 NPS 1/2 to 2, screwed.

.2 NPS2 1/2 and over, plain end, welded.

.2 Copper tube: to ASTM B837.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

.4 Brazing: to ASTM B837.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.
.2 Steel pipe flanges and flanged fittings: to ASME B16.5.
.3 Welding: butt-welding fittings.
.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
.5 Bolts and nuts: to ASME B18.2.1.
.6 Nipples: schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

.1 Cast copper fittings: to ASME B16.18.
.2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated plug type. Refer to Section 23 05 23.04 – Valves – Lubricated Plug.

.2 NPS 2 and under, screwed.

.3 NPS 2-1/2 and over, flanged.

.4 Suitable for the temperature to which exposed.

.5 Certified by Canadian Gas Association (CGA).

2.5 PRESSURE REGULATING VALVES

.1 High tensile iron body with synthetic rubber diaphragm and valve disc.

.2 CSA listed for use in natural gas piping systems.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PIPING

.1 Existing gas piping is distributed through the building at 34 kPA pressure.

.2 Install gas piping in accordance with Section 23 05 05 - Installation of Pipework and CAN/CSA B149.1.

.3 Ream pipe ends. Clean scale and dirt, inside and outside before and after assembly.

.4 During construction, protect all openings in piping and equipment, by capping or plugging to prevent entry of dirt.

.5 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.6 Slope piping down in direction of flow to low points.

.7 Use eccentric reducers at pipe size change installed to provide positive drainage.

.8 Provide clearance for access for maintenance of equipment, valves and fittings.

.9 Use dielectric type fittings where buried service enters and connects to building piping.

.10 Joints:

- .1 Gas service inside building
  - .1 Screw or weld NPS 2 and under.
  - .2 Weld NPS 2-1/2 and over.
- .2 Gas service in ceiling plenums - weld all sizes.
- .3 Exterior gas piping, including rooftop piping - weld all sizes and use approved flexible connectors at the point of connection to gas fired equipment.

.11 For exterior piping, including rooftop piping, allow for expansion with suitable anchors, guides and expansion loops to prevent undue stress on any part of the system.

.12 Install drip points:

- .1 At low points in piping system.
- .2 At connections to equipment.

.13 All exposed exterior piping, including rooftop pipe and fittings shall be cleaned after assembly, painted with a metal primer and given two coats of yellow exterior enamel paint. Refer also to Section 09 91 13 - Exterior Painting.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.

.2 Install valves at branch take-offs, at all equipment for isolation, and as indicated.

3.4 PRESSURE REGULATING VALVES

.1 Provide pressure regulating valve at each item of gas equipment. Size valve and set pressure as required for equipment capacity.

.2 Pipe relief vent to outdoors and/or away from any building openings and AHU air intakes. Comply with CAN/CSA B149.1-10.

3.5 CONNECTIONS TO EQUIPMENT

.1 Install unions or flanges in connections to all equipment and specialty components.

.2 Arrange piping connections to allow ease of access and for removal of equipment.

.3 Align and independently support piping connections adjacent to equipment to prevent piping stresses being transferred.

3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.

.2 Notify the Departmental Representative and the Inspection Authority having jurisdiction, 48 hours in advance of intended test date.

.3 Examine piping for leaks. Remake all leaking connections and joints.

.4 Submit final gas inspection certificate.

.5 Performance Verification:

.1 Refer to Section 23 08 01 - Performance Verification – Mechanical Piping Systems.

3.7 ADJUSTING

.1 Purging: purge all piping after pressure test in accordance with CAN/CSA B149.1.

.2 Coordinate with Departmental Representative for connection to and purging of existing piping.

.3 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains.

.3 Authority having jurisdiction to approve entire installation. Submit test and inspection certificate.

3.8 CLEANING

.1 Cleaning: in accordance with Section 23 08 02 - Cleaning and Start-Up and CAN/CSA B149.1.

.2 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for steel piping, valves and fittings for hydronic systems.

1.2 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results for HVAC

.2 Section 23 05 23.01 - Valves – Bronze

.3 Section 23 05 23.02 - Valves – Cast Iron

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

.5 Section 23 08 02 - Cleaning and Start-Up

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1-2005, Gray Iron Pipe Flanges and Flanged Fittings.
.2 ASME B16.3-2011, Malleable Iron Threaded Fittings.
.3 ASME B16.5-2009, Pipe Flanges and Flanged Fittings.
.4 ASME B16.9-2007, Factory-Made Wrought Buttwelding Fittings.
.5 ASME B18.2.1-1996 (R2005), Square and Hex Bolts and Screws (Inch Series).
.6 ASME B18.2.2-2005, Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A47-2009, Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
.3 ASTM A536-84 (2009), Standard Specification for Ductile Iron Castings.

.3 American Water Works Association (AWWA).

.1 AWWA C111-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

.1 CAN/CSA W48-06 (R2011), Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

1.4 SUBMITTALS

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

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Include the following:

.1 Piping type and fittings

.3 Quality Control Check Sheets

.4 Closeout Submittals.

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:

1.5 QUALITY ASSURANCE

.1 Health and Safety.

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 – Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets for each piping system to include the following information:

.1 Pipe material and specifications

.2 Pipe support type and spacing

.3 Pipe support finish

.4 Details of pipe attachment to structure

.5 Access to valves and accessories

.6 Pipe slope where specified

.7 Pipe insulation (where applicable and specified)

.8 Pressure and leak testing report

.9 Comments on seismic installation

.10 Maintenance instructions

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal.

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 PIPE

.1 Steel Pipe:

.1 Schedule 40 to ASTM A53 Grade B.

.2 Use for the following systems:

.1 Hot water heating

.2 Relief valve vents

2.2 PIPE JOINTS – STEEL PIPING

.1 NPS 2 and under: screwed fittings, except where otherwise noted, with teflon tape and rectroseal teflon paste or lead free pipe dope.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W47.1.

.3 Flanges: raised face, steel weld neck, lap or back-welded slip on type. Use flat face for attachment to cast iron valves.

.4 Bolts and Nuts, carbon steel: to ASME B18.2.1 and ASME B18.2.2.

.5 Flange gaskets:

.1 To AWWA C111.

.2 Up to 860 kPa system pressure - non-asbestos gaskets for mating surfaces.

.3 Over 860 kPa system pressure - stainless steel spiral wound non-asbestos gaskets.

2.3 PIPE FITTINGS – STEEL PIPE

.1 Pipe fittings, screwed, flanged or welded:

.1 Cast iron pipe flanges: Class 125 to ANSI B16.1.

.2 Cast iron screwed fittings: Class 125 to ANSI B16.3.

.3 Steel pipe flanges and flanged fittings: to ANSI B16.5.

.4 Steel butt-welding fittings: to ANSI B16.9a.

.5 Unions, malleable iron ground joint type: Class 150 to ASME B16.3.

2.4 **VALVES**

.1 Connections:

.1 NPS 2 and smaller: ends for soldering.

.2 NPS 2 1/2 and larger: flanged ends.

.2 Gate Valves: Application: isolating equipment, control valves, pipelines:

.1 NPS 2 and under:

.1 Class 125, Rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 Rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.

.3 Globe valves: Application: throttling, flow control, emergency bypass:

.1 NPS 2 and under:

.1 Globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 With composition disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.

.4 Balancing, for TAB:

.1 Circuit balancing valves, as specified Section 23 05 23.01 - Valves - Bronze.

.5 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

.6 Swing check valves:

.1 NPS 2 and under:

.1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

.7 Silent check valves:

.1 NPS 2 and under:

.1 As specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 1/2 and over:

.1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

.8 Ball valves:

.1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PIPING INSTALLATION

.1 Ream pipe ends. Clean scale and dirt, inside and outside before and after assembly. Remove foreign material from piping.

.2 During construction, protect all openings in piping and equipment, by capping or plugging to prevent entry of dirt.

.3 Screw or weld (unless otherwise specified) all piping systems up to NPS 2.

.4 Install piping to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.

.5 Avoid piping in exterior walls unless otherwise directed. If required, install this piping protected from the outside by the building insulation and vapour barrier.

.6 Maintain a minimum of 25 mm space between adjacent flanges or pipe insulation, whichever has the larger diameter.

.7 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.8 Saddle type branch fittings may be used on mains, if branch line is half size or smaller than main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

.9 Use long radius elbows.

.10 Install all thermometer wells and immersion sensor wells specified under the Controls Section. Where wells will restrict flow in small diameter pipes (NPS 1-1/2 and smaller) install a section of oversized pipe at least NPS 2.

.11 Remake leaking joints using new materials, do not caulk or cement leaking threaded joints.

.12 Use eccentric reducers at pipe size changes, flush on top side, to permit positive venting and drainage.

.13 Do not use thread protection couplings, close nipples, running nipples or street elbows.

.14 Install dielectric type unions or flanges where copper piping connects to steel.

.15 Avoid locating water and drain piping over electrical equipment. Where this is unavoidable, provide galvanized drip pans under such pipe and weld piping and fittings. Provide drain and piping from drip pans to satisfactory floor drain.

.16 Bull head tees shall not be used for converging flows.

.17 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.18 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.19 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.20 Assemble piping using fittings manufactured to ANSI standards.

3.3 HOSE BIBBS

.1 Install drain valves and hose bibbs at each low point in the piping system and at specific drain locations shown on the drawings.

.2 Install NPS 1-1/2 or NPS 3/4 drain valve/hose bibb on line sizes less than NPS 1-1/2 at all low points in the piping systems to facilitate draining.

.3 Install drain valves in lieu of hose bibbs for systems operating at over 93°C.

.4 Install a hose end adaptor on the discharge side of each drain valve or pipe to drain, where indicated.

.5 Clearly label/tab drain hose bibs as “Drain Valves”.

3.4 PIPE GRADING

.1 Grade all piping to provide positive drainage and venting. Slope as follows:

.1 Supply mains and branches - up in the direction of flow, minimum 1:480.

.2 Return mains and branches - down in the direction of flow, minimum 1:480.

.3 Reverse return supply and return mains - up in the direction of flow, minimum 1:480.

.4 Grade horizontal drainage and vent piping down in direction of flow, 2% minimum.

.5 On closed system, equip low points with 20 mm drain valves. Provide, at high points on lines and on equipment connections, collecting chambers and high capacity float operated air vents.

3.5 CONNECTIONS TO EQUIPMENT AND TO EXISTING PIPING

.1 Install unions or flanges at connections to all equipment and specialty components and at all connecting points to existing systems which, for reasons of separation for testing, is require to be blank flanged or capped.

.2 Connect to equipment in accordance with manufacturer's instruction unless otherwise noted.

.3 Arrange piping connections to allow ease of access and for removal of equipment.

3.6 EXPANSION OF PIPING

.1 Install all piping systems with due regard and provision for expansion avoiding strain or damage to equipment and building. Pay particular attention to piping running horizontal across building expansion joints and provide adequate expansion and contraction for all such piping.

.2 Provide all required expansion compensators, piping loops and swing connections.

.3 Provide anchors, where required and shown. Anchors shall be fabricated from mild steel plate and structural steel angle and channel sections, in accordance with ANSI B.31.1.

.4 Expansion pipe loops shall be of all welded construction with long radius elbows.

.5 Install expansion loops, cold sprung 50% of the calculated expansion.

.6 Install at least three (3) elbows in all branch connections. Where space does not permit 3 elbows, install braided flexible pipe connectors in accordance with manufacturers' recommendations. Three (3) elbow branch connections shall have sufficient developed length to ensure that excessive stresses are not generated in the piping and in no case less than 900mm.

3.7 VALVE INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install gate or ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

3.8 CIRCUIT BALANCING VALVES

.1 Install circuit balancing valves for balancing each individual terminal unit and as indicated.

3.9 FLUSHING AND CLEANING

.1 Coordinate with Section 23 25 00 – HVAC Water Treatment Systems.

.2 Flush and clean in presence of Departmental Representative.

.3 Flush after pressure test for a minimum of 4h.

.4 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8h.

.5 Refill system with clean water. Circulate for at least 4h. Clean out strainer screens/baskets regularly. Then drain.

.6 Refill system with clean water. Circulate for at least 2h. Clean out strainer screens/baskets regularly. Then drain.

.7 Drainage to include drain valves, dirt pockets, strainers, low points in system.

.8 Re-install strainer screens/baskets only after obtaining Departmental Representative's approval.

.9 Refer to Section 23 08 02 - Cleaning and Start-Up.

3.10 FILLING OF SYSTEM

.1 Refill system with clean water, adding water treatment as specified.

3.11 FIELD QUALITY CONTROL

.1 Testing:

.1 Fill piping system with water and apply a preliminary test pressure of 172 kPa (25psig). Purge all air from piping. If leaks are detected, relieve pressure and correct the leak(s).

.2 Apply hydrostatic pressure in increments of 172 kPa (25 psig), until maximum test pressure is reached.

.3 Minimum test pressure is 1.5 x design pressure or 860kPa (125 psig), whichever is greater.

.4 Maximum test pressure is less than any system component rating under test.

.5 Hold pressure for 24 hours and confirm no leaks and that pressure is maintained.

.6 Submit test report to Departmental Representative.

.2 Balancing:

.1 Refer to Section 23 05 93 – Testing, Adjusting and Balancing for HVAC, for applicable procedures.

3.12 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation of Hydronic Specialties Equipment.

1.2 RELATED SECTIONS

.1 Section 22 42 01 - Plumbing Specialties and Accessories

.2 Section 23 08 01 - Performance Verification – Mechanical Piping Systems

1.3 REFERENCES

.1 American Society for Testing and Materials, (ASTM).

.1 ASTM A47-2009, Specification for Ferritic Malleable Iron Castings.

.2 ASTM A516/A516M-10, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.3 ASTM A536-84 (2009), Specification for Ductile Iron Castings.

.4 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.

.2 Canadian Standards Association (CSA International).

.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit shop drawings for the following:

.1 Expansion tank

.2 Suction diffusers

.3 Air vents

.4 Strainers

.5 Pressure reducing and relief valves

.3 Quality Control Check Sheets

1.5 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. Include all specified equipment.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 - Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the DCC Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets for each piping system to include the following information:

.1 List all hydronic specialties as specified in this section:

.1 Expansion tank

.2 Air vents

.3 Strainers

.4 Pressure relief valves

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 AIR SEPARATOR

.1 The air separator must be designed, constructed and tested in accordance with the ASME Boiler and Pressure Vessel Code and stamped 125, 150, 250 and 300 psig design pressure.

.2 ASME B16.5 flanges shall be provided on all units 75mm or larger.

.3 The air separator shall have flanged inlet and outlet connections and strainer removal connection.

.4 Removable strainer shall be stainless steel with 4.8mm diameter perforations and a free area of not less than five times the cross-sectional area of the connecting pipe.

.5 There shall be a bottom connection for blowdown cleaning.

2.2 AIR VENTS AUTOMATIC – HIGH CAPACITY TYPE

.1 Non-Serviceable Type

.1 Casing and internal parts suitable for system operating pressure and temperature.

.2 All metal construction with outlet threaded to accept vent tubing connection.

.3 Automatic float type.

.4 Shrader type venting valve.

2.3 AIR VENTS MANUAL – HIGH CAPACITY

.1 Globe Type

.1 Bronze body, union bonnet, screwed, 450 brinell hardened stainless steel trim and plug type disc.

2.4 PIPE LINE STRAINER

.1 NPS 2 and under: bronze body to ASTM B62, screwed connections, Y pattern.

.2 NPS 2 1/2 and over: cast iron body to ASTM, Class 30, flanged connections.

.3 NPS 2 and over: Y or T type with ductile iron body to ASTM A536 or malleable iron body to ASTM A47M, grooved ends.

.4 Blowdown connection: NPS 1.

.5 Basket Screen: stainless steel or brass with 1.19 mm perforations.

.6 Working pressure: 860 kPa.

2.5 PRESSURE REDUCING STATION – COLD WATER

.1 Screwed, bronze or cast iron body, suitable to 1380 kPa, composition seat.

.2 Each reducing station to include:

.1 Gate valve, strainer, union, pressure reducing valve, union, gate valve.

.2 Bypass with globe valve.

.3 20 mm relief valve.

2.6 PRESSURE RELIEF VALVES - WATER

.1 Screwed, bronze body or cast iron body with expanded outlet.

.2 ASME rated.

.3 Coordinate with Heat Exchangers Schedules.

Part 3 Execution

3.1 GENERAL

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines and blow off connections to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request and follow DCC Representative's directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 AIR VENTS

.1 Install air vents at high points in the piping systems where shown on the drawings.

.2 Install on tees and not on horizontal pipe runs or elbows.

.3 Install isolating gate valve ahead of each vent valve.

.4 Pipe air vent discharge connections to nearest building drain.

3.3 STRAINERS

.1 Install in horizontal piping.

.2 Ensure clearance for removal of basket.

3.4 PRESSURE SAFETY RELIEF VALVES - WATER

.1 Install pressure relief valve(s) to prevent over pressurizing.

.2 Pipe relief valve to drain.

3.5 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification – Mechanical Piping Systems, supplemented as specified herein.

3.6 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Air Separator: Remove and clean strainer after 24 hours operation and after 30 days operation.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials, equipment selection, installation and start up for hydronic system pumps.

1.2 RELATED SECTIONS

.1 Section 23 08 01 - Performance Verification of Mechanical Piping Systems

.2 Section 23 21 14 - Hydronic Specialties

.3 Section 25 30 02 - EMCS: Field Control Devices

1.3 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).

.1 Standard 90.1-2013 Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC).

.3 Canadian Standards Association (CSA International).

.1 CAN/CSA-B214-07, Installation Code for Hydronic Heating Systems.

1.4 SUBMITTALS

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

.2 Submit shop drawings to indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Pump make and model number

.3 Wiring and schematic diagrams.

.4 Dimensions and recommended installation.

.5 Pump performance and efficiency curves.

.6 Controls

.3 Closeout Submittals:

.1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 Description of pumps and accessories, giving manufacturer's name, type, model, year, capacity.

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

1.5 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Do pump selection and sizing to: CAN/CSA-B214.

2.2 IN-LINE CIRCULATORS

.1 Suitable for a maximum working pressure of 860 kPa and maximum temperature of 107° C.

.2 Volute: cast iron, radially split, with screwed or flanged design suction and discharge connections.

.3 Impeller: alloy steel, stainless steel or carbon-fibre-reinforced-composite.

.4 Shaft: alloy steel with bronze sleeve bearing, integral thrust collar.

.5 Seal assembly: Canned motor construction.

.6 Motor: to NEMA MG 1, resilient mounted, drip proof, sleeve bearing, or X4D.

.7 Motor with integral variable frequency drive, with thermal and overload protection, BACnet card, suitable for connection to BACnet bus.

.8 Voltage: Refer to equipment schedules

.9 Capacity: Refer to equipment schedules

Part 3 Execution

3.1 INSTALLATION

.1 Do Work in accordance with CAN/CSA-B214.

.2 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions – follow manufacturer’s recommendations. Install with bearing lubrication points accessible.

.3 Refer to manufacturer's installation instructions for details.

.4 Pipe drain tapping to floor drain.

.5 Check rotation prior to start-up.

.6 Install pressure gauge test cocks.

3.2 START-UP

.1 General

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Measure pressure drop across strainer when clean and with flow rates as finally set.

3.3 PERFORMANCE VERIFICATION (PV)

.1 General

.1 In accordance with Section 01 91 13 - General Commissioning (Cx)

.2 In accordance with manufacturer's recommendations.

.2 Assumptions: these PV procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.3 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.4 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.5 Commissioning Reports: In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements reports supplemented as specified herein. Reports to include:

.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Report forms as specified Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

.3 Pump performance curves (family of curves).

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Work includes water treatment for the complete hot water heating piping system.

.2 This Section includes the minimum requirements and level of quality for the system.

1.2 RELATED SECTIONS

.1 Section 23 08 02 - Cleaning and Start Up

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code.

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

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

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

.2 Submit shop drawings for the following:

.1 Chemical data (with MSDS sheets), quantities, procedures.

.2 Data of treatment chemicals used in existing hot water heating system. Test and determine prior to shop drawing submittal.
Note: Preference is to use the same chemicals used in the existing system that we are connecting into; confirm supplier with the Owner. As a minimum, the supplier will have the existing system water treatment tested, and provide an affidavit that the proposed treatment is compatible with the existing system chemicals.

.3 Confirm that proposed chemicals are compatible with existing Base system treatment chemicals.

.4 Installation requirements

.5 Test procedures

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Quality Control Check Sheets

.5 Provide written report containing log and procedure of system cleaning, giving times, dates, problems encountered and condition of water.

.6 Submit written report containing test results and list of chemicals added from time of commissioning to acceptance.

.7 Notify the Departmental Representative 48 hours prior to chemical cleaning so that work may be verified and reviewed.

.8 Closeout Submittals:

.1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

.2 Include following:

.1 Log sheets as recommended by manufacturer and the Departmental Representative.

1.5 QUALITY ASSURANCE

.1 The Water Treatment Company shall meet the following qualifications:

.1 Minimum of ten years of recent experience in cleaning and water treatment of plumbing and hydronic water systems, for a variety of industrial processes and building systems.

.2 Submit names of personnel to perform water treatment and the relevant experience to the Departmental Representative within 90 days of award of contract.

.2 Water treatment chemicals and treatment process shall be supplied and performed by the Contractor. This work shall be supervised by the Water Treatment Specialist who, upon completion, shall certify that the process is satisfactory and submit a report outlining the cleaning operation and the treatment process.

.3 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 – Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Chemical data (with MSDS sheets), quantities, procedures.

.2 Installation and performance final certificate completed.

.3 Commissioning completed.

.4 Training completed.

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.7 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.8 SCOPE

.1 Confirm on site and with Departmental Representative. Chemicals shall be compatible with the chemicals used in existing system (connected into).

.2 Provide cleaning and chemical treatment for every phase of the work – refer to construction phasing.

.3 Provide for cleaning and degreasing of installed hot water heating system piping.

.4 Provide for cleaning and disinfection of installed domestic hot and cold systems.

.5 Provide all temporary strainers, connections and by-pass lines as required.

.6 Provide chemical treatment for the following systems:

.1 All installed piping and components connecting to existing hot water heating system.

.7 Note: do not clean existing piping and air handling coils with cleaning (caustic) solution.

1.9 WATER TREATMENT SERVICE

.1 The Water Treatment Specialist shall provide supervision of installations, set-up and adjustments and shall submit a written report on system operations.

.2 All chemicals, feed systems and test equipment shall be provided by the Water Treatment Specialist.

.3 Treatment chemicals shall not contain hydrazine and shall be non-foaming.

.4 The Water Treatment Specialist shall instruct the maintenance personnel before substantial completion. Written instructions of the treatment, dosages control charts and test procedures shall be included in the maintenance manuals.

.5 The Water Treatment Specialist shall provide sufficient chemicals to treat the system from the time of commissioning to acceptance of the system.

.6 Provide a test kit suitable for all chemical treatments used. The test kit shall be made available for on-site tests and provide a TDS meter to check conductivity. Hand over the kit to the Departmental Representative at project completion - obtain receipt.

Part 2 Products

2.1 MANUFACTURER

.1 Equipment, chemicals, service provided by one supplier.

.2 Chemicals shall be compatible with the chemicals used in existing system (connected into).

2.2 MATERIALS

.1 System Cleaner: Use a Sodium Metasilicate, Sodium Nitrite and a wetting agent compound, which in solution removes grease and petroleum products. Concentration level to be determined by Water Treatment Specialist.

.2 Closed System Treatment (Hot Water Heating): Use a Borated Nitrite-Molybdate based corrosion inhibitor. Maintain levels at 200 to 400 ppm. Note: The use of Nitrite only, Molybdate only or Sulphite only will not be accepted.

2.3 EQUIPMENT

.1 Provide all supply feed equipment and related components as required to treat systems.

2.4 BYPASS POT FEEDER

.1 All closed hot water and chilled water systems shall have a by-pass chemical pot feeder with a 7.6 litre capacity. It shall be constructed of heavy duty cast iron or welded steel (suitable for 1380 kPa [200 psi] working pressure), with quick opening cap and complete with 20 mm NPT connections. Isolating valves shall be installed on the inlet, outlet and drain.

2.5 SIDESTREAM FILTER

.1 All closed hot water and chilled water systems shall have a sidestream filter housing of steel construction using a 250 mm x 30 micron filter cartridge, with a minimum flow rate of 35 litres/minute. A **Flow Indicator** shall be installed in conjunction with the sidestream filter. Connections shall be 20 mm MxFNPT and all isolating valves shall be installed as per manufacturer's instructions. Include 6 filter cartridges.

2.6 TOTALIZING MAKE-UP PULSE WATER METER

.1 Cast Bronze body, 20 mm NPT connections, thermoplastic rotor and gear train, rated at 1034 kPa [150 psi] maximum operating pressure.

.2 Pulse meter to provide input to BAS.

2.7 CHEMICAL FEED PIPING:

.1 Schedule 40 black steel

2.8 CORROSION COUPON AND HOLDER ASSEMBLY:

.1 Mild steel corrosion coupon.

.2 Holder, 20 mm or 25 mm NPT male connection.

.3 Provide malleable or cast iron cross, 20 mm or 25 mm NPT female connection.

2.9 TEST EQUIPMENT

.1 Provide one set of test equipment for each system to verify performance.

.2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

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 CLEANING OF MECHANICAL SYSTEM

.1 Coordinate cleaning of systems with Section 23 08 02 – Cleaning and Start-Up.

.2 Provide copy of recommended cleaning procedures and chemicals for approval by the Departmental Representative.

.3 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials.

.4 Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.

.5 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.

.6 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.7 Disposal of cleaning solutions approved by authority having jurisdiction.

3.3 FIELD QUALITY CONTROL

.1 Start-up:

.1 After piping and all connections to existing system is complete, start-up water treatment systems in accordance with manufacturer's instructions.

.2 Commissioning:

.1 Comply with Section 01 91 13 – Commissioning Requirements.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After start-up and before TAB of connected systems.

.3 Pre-commissioning Inspections: verify:

.1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.

.2 Suitability of log book.

.3 Currency and accuracy of raw/initial water analysis.

.4 Required quality of treated water.

.4 Commissioning procedures - applicable to Water Treatment Systems:

.1 Monitor performance continuously during commissioning of connected systems and until acceptance of project.

.2 Establish test intervals, regeneration intervals.

.3 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.

.4 Visit project after commissioning is satisfactorily completed to verify that performance remains as set during commissioning.

.5 Advise the Departmental Representative in writing on matters regarding installed water treatment systems.

.5 Commissioning procedures - Closed Circuit Hydronic Systems:

.1 Establish chemical feed required.

.2 Record types, quantities of chemicals applied.

.6 Training:

.1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.

.7 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.8 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by the Departmental Representative.

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials, accessories and installation of venting for heating boilers.

.2 Venting system for boilers shall be coordinated with the boiler requirements, and is a responsibility of boiler supplier, venting is considered a part of the boiler package.

.3 Note the dimensions, venting to reuse existing roof openings and operating weights are to meet limitations of the existing boiler room. Refer to the drawings.

1.2 RELATED SECTIONS

.1 Section 23 52 00 - Heating Boilers

1.3 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.2 Underwriters' Laboratories of Canada (ULC)

.3 Canadian Gas Association

.1 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.

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

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

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

.1 Submit drawings stamped and signed by Professional Engineer registered or licensed in the Province of BC, Canada.

.2 Indicate following:

.1 Sizing calculations

.2 Detailed project specific installation drawing and instructions.

.3 Methods of sealing sections.

.4 Methods of expansion.

.5 Details of thimbles.

.6 Supports, and support details.

.7 Termination per manufacturer's recommendation.

.3 Closeout Submittals:

.1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 QUALITY ASSURANCE

.1 Install boiler vent in accordance with manufacturer's recommendations and the current Regulations of the Province of BC.

.2 Certificates:

.1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

Part 2 Products

2.1 FLUE VENTING SYSTEMS

.1 General:

.1 Provide complete venting system from the boilers connections to termination above roof, or as shown.

.2 Venting systems for boilers shall be UL 1738/ULC S636 and is for use with listed natural gas burning appliances that produce continuous flue-gas temperatures not exceeding 288°C (550°F).

.3 Suitable for condensing boiler service.

.4 Material:

.1 Prefabricated double wall sections

.2 Inner liner: AL29 4C stainless-steel.

.3 Smooth wall design to minimize turbulence and flow resistance. Welded seams, free of minute cracks or crevices to fail or collect corrosive condensation.

.4 Aluminized steel outer jacket.

.5 Terminate above roof to meet code requirements and boiler manufacturer's recommendations.

.6 Construction in accordance with UL/ULC certification

.7 Accessories:

.1 Vent supports and brackets:

.2 Fittings

.3 Fasteners

Part 3 Execution

3.1 INSTALLATION - GENERAL

.1 Follow manufacturer's and SMACNA installation recommendations (including assembly instructions, product technical bulletins, handling, storage and installation instructions, and datasheet) for shop fabricated components.

.2 Suspend horizontal sections at 1.5 m centres and at each joint.

.3 Support vents at bottom, roof and intermediate levels.

.4 Install thimbles where penetrating roof, floor and ceiling. Pack annular space with heat resistant caulking.

.5 Install flashings on chimneys penetrating roofs, as indicated.

3.2 CLEANING

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation of heating hot water boilers (B-01, B-02 and B-03).

.2 Venting system for boilers shall be coordinated with the boiler requirements, and is a responsibility of boiler supplier, venting is considered a part of the boiler package.

.3 Note the dimensions, venting to reuse existing roof openings and operating weights are to meet limitations of the existing boiler room. Refer to the drawings.

1.2 RELATED SECTIONS

.1 Section 23 51 00 - Breeching, Chimneys and Stacks

1.3 REFERENCES

.1 American Boiler Manufacturer's Association (ABMA)

.2 American National Standards Institute (ANSI)

.1 ANSI Z21.13-2004/CSA 4.9-2004, Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.3 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.

.4 Canadian Gas Association (CGA)

.1 CAN1-3.1-77 (R2001), Industrial and Commercial Gas-Fired Package Boilers.

.2 CAN/CSA-B149.1-05, Natural Gas and Propane Installation Code.

.5 Canadian Standards Association (CSA International)

.1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CAN1-3., Canadian Electric Code

.6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.7 Install packaged boiler(s) in accordance with current Regulations of the Province of BC.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

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

.1 Submit drawings stamped and signed by Professional Engineer registered or licensed in the Province of BC, Canada.

.2 Indicate the following:

.1 Unit capacity

.2 General arrangement showing terminal points, instrumentation test connections.

.3 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.4 Loadings, anchor bolt arrangements.

.5 Piping hook-ups.

.6 Equipment electrical drawings.

.7 Controls

.8 Burners.

.9 All miscellaneous equipment.

.10 Flame safety control system.

.11 Breeching and flue gas vent system, materials and installation details.

.3 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75%, 100% of design capacity.

.2 Radiant heat loss at 100% design capacity.

.3 Closeout Submittals:

.1 Submit operation and maintenance data in accordance with Section 01 78 00 - Closeout Submittals.

.2 Submit certificate of inspection from Province of British Columbia Safety Authority.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 HOT WATER BOILERS

.1 Packaged high efficiency condensing boiler: complete with burner and necessary accessories and controls, and ready for attachment of water supply, return and drain piping, fuel piping, electrical connections, and chimney connection. UL/ULC labelled.

.2 Stainless steel and copper heat exchangers are only materials acceptable. Boiler shall be suitable for operation with the existing heating system, at higher pH values of loop water.

.3 Minimum 95% combustion efficiency.

.4 The boiler shall be designed to withstand 100° F delta "T"

.5 Designed and constructed in accordance with ANSI/ASME Boiler and Pressure Vessel Code requirements.

.6 The pressure vessels shall bear Canadian Registration Number (CRN) for The Province of BC before being shipped from the factory.

.7 Electrical components CSA approved and CSA labeled.

.8 The packaged boiler must receive factory tests to check the construction, controls, and operation of the unit. Boilers to be test fired before shipment.

.9 Include erection and wiring diagrams and an operating and maintenance manual with boiler package.

.10 Check all available drawings and ensure that the boiler proposed will fit in the space allotted, can fit through the Mechanical room door, and can be maintained and operated in a normal manner without difficulty.

.11 Maximum operating weight 1150 kg [2500 lb].

.12 Construction:

- .1 Packaged ASME 550 kPa pressure rated water boiler, designed to resist thermal shock.
- .2 Rated for 93^{o}C [200^{o}F] operating temperature.
- .3 Boiler shall be furnished with an adequate number of tappings and inspection openings to facilitate internal boiler inspection and cleaning.
- .4 Boiler shall be complete with a heavy gauge insulated metal jacket, finished with heat resistant enamel paint.
- .5 All exposed boiler components to be insulated. If not factory insulated, boiler supplier shall include and arrange for field application.
- .6 Provide secure attachment points for seismic anchoring.

.13 Gas Burner and Control Equipment

- .1 Boiler shall be furnished with a high quality forced draft, flame retention gas burner.
- .2 Modulating control.
- .3 Burner shall be complete with integral motor and blower for supplying sufficient combustion air.

.4 Provide all standard trim items and controls as described in manufacturers published product specification including the following:

.1 Flue gas thermometer.

.2 Thermometer and pressure gauge.

.3 Water temperature control operator.

.4 High limit safety control with manual reset.

.5 Low water cutoff with manual reset (manual reset should not be necessary after electrical power interruption).

.6 Built in air eliminator

.7 ASME safety relief valve(s) to release entire boiler capacity.

.8 Automatic gas valve operator.

.9 Auxiliary safety shut-off valve.

.10 Pilot solenoid valve.

.11 Pilot ignition assembly.

.12 Ignition transformer.

.13 Main manual gas shut-off valve.

.14 Pilot cock.

.15 Pilot and main gas pressure regulators.

.16 Air safety switch.

.17 Electronic combustion safety control with UV sensor.

.14 Operating Controls:

.1 Provide complete control package for boilers, including one panel for each boiler.

.2 Boiler shall be compatible for communication with BACnet building control system. It shall include BACnet interface/card.

.15 Accessories:

.1 Modulating gas burner (5:1 turndown).

.2 Auxiliary low water cutoff.

.3 Alarm horn.

.4 Indicator lights - as specified.

.16 Boiler Venting System

.1 Boiler venting system shall be designed and supplied by boiler supplier in order to ensure correct selection of materials, sizing and coordination with boiler selection.

.2 Include for venting from boilers, up to termination above roof using existing openings – refer to the drawings.

.3 Refer to Section 23 51 00 – Breeching, Chimneys and Stacks.

.17 Provide condensate neutralizer for each boiler, sized for condensate flow and so that outlet flow can be safely discharged to sanitary system.

.18 Standard of Acceptance: HARSCO SC 3000.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install in accordance with ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of the Province of BC and manufacturers recommendations.

.2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.

.3 Maintain clearances as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.

.4 Mount units level.

.5 Pipe condensate to neutralizer.

.6 Natural gas fired installations - in accordance with CAN/CSA-B149.1.

.7 Anchor in compliance with the Seismic Requirements.

3.3 MOUNTINGS AND ACCESSORIES

.1 Safety valves and relief valves:

.1 Run separate discharge from each valve.

.2 Run drain pipe from each valve outlet to above nearest drain.

3.4 FIELD QUALITY CONTROL

.1 Commissioning:

.1 Manufacturer to:

.1 Certify installation.

.2 Start up and commission installation.

.3 Carry out on-site performance verification tests.

.4 Demonstrate operation and maintenance.

.2 Provide Departmental Representative at least 24 hours notice prior to inspections, tests, and demonstrations.

.3 Submit written report of inspections and test results. Include default values and set-points in maintenance instructions.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:

.1 Start-up testing and verification of systems.

.2 Check out demonstration or proper operation of components.

.3 On-site operational tests.

.2 Related Sections.

.1 Section 01 33 00 - Shop Drawings and Product Data Samples.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 01 91 13 - General Commissioning (Cx) Requirements.

.4 Section 01 79 00 - Demonstration and Training.

.5 Section 23 05 00 - Common Work Results for HVAC

.6 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

.7 Section 23 08 00 - Commissioning - Mechanical Systems

.8 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

.1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:

.1 Outage of main power supply in excess of back-up power sources, provided that:

.1 Automatic initiation of back-up was accomplished.

.2 Automatic shut-down and re-start of components was as specified.

.2 Failure of communications link, provided that:

.1 Controller automatically and correctly operated in stand-alone mode.

.2 Failure was not due to failure of any specified EMCS equipment.

.3 Functional failure resulting from individual sensor inputs or output devices, provided that:

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

.3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 DESIGN REQUIREMENTS

.1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Shop Drawings and Product Data Samples.

.2 Final Report: submit report to Departmental Representative.

.1 Include measurements, final settings and certified test results.

.2 Bear signature of commissioning technician and supervisor

.3 Report format to be approved by Departmental Representative before commissioning is started.

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

.1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

1.6 COMMISSIONING

.1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative and PWGSC Commissioning Manager.

.3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:

.1 Location and part of system to be tested or commissioned.

.2 Testing/commissioning procedures, anticipated results.

.3 Names of testing/commissioning personnel.

.4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

.5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.6 Load system with project software.

.7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative and PWGSC Commissioning Manager.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system using procedures prescribed by the Commissioning Manager Departmental Representative.

.3 Commission integrated systems using procedures prescribed by Commissioning Manager Departmental Representative.

.4 Debug system software.

.5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

.6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.

- .1 General: consists of field tests of equipment just prior to installation.
- .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
- .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
- .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
- .5 Additional instruments to include:
  - .1 DP transmitters.
  - .2 DP switches used for dirty filter indication and status.
- .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source and to BECC.
- .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
- .8 Departmental Representative to mark instruments tracking within 0.5% in both directions as "approved for installation".
- .9 Transmitters above 0.5% error will be rejected.
- .10 DP switches to open and close within 2% of set-point.

.2 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each A-to-D convertor.

.3 Test and calibrate each AI using calibrated digital instruments.

.4 Test each DI to ensure proper settings and switching contacts.

.5 Test each DO to ensure proper operation and lag time.

.6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

.11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.

.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final startup testing.

.3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and PWGSC Commissioning Manager and provide:

.1 2 technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 Departmental Representative's acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final startup testing.

.5 O&M personnel to assist in commissioning procedures as part of training.

.6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.

.7 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.8 Operate systems as long as necessary to commission entire project.

.9 Monitor progress and keep detailed records of activities and results.

.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.

.1 Repeat tests during low partial load operation (shoulder season – late fall), and peak load season (mid-winter). Make adjustments to sequences and set-points as required.

.2 Prior to beginning of 30 day test demonstrate that operating parameters (set-points, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.

.1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.

.3 Test to last at least 30 consecutive 24 hour days.

.4 Tests to include:

.1 Trend log and alarm log analysis that confirm acceptable operation of the system.

.2 Demonstration of correct operation of monitored and controlled points.

.3 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.5 System will be accepted when:

.1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.

.2 Requirements of Contract have been met.

.6 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.

.7 Correct defects when they occur and before resuming tests.

.5 Commissioning Manager Departmental Representative to verify reported results.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to Commissioning Manager Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

.2 Related Sections.

.1 Section 01 33 00 - Shop Drawings and Product Data Samples.
.2 Section 23 05 00 - Common Work Results for HVAC
.3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
.4 Section 23 08 00 - Commissioning - Mechanical Systems
.5 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

.1 CDL - Control Description Logic.

.2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.

.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.

.1 List name of trainer, and type of visual and audio aids to be used.
.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

.3 Submit reports within one week after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

.1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.

.2 Departmental Representative reserves right to approve instructors.

1.5 INSTRUCTIONS

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.

.2 Training to be project-specific.

1.6 TIME FOR INSTRUCTION

.1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids, and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.8 TRAINING PROGRAM

.1 To be in 2 phases over 6 month period.

.2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative and PWGSC Commissioning Manager.

.1 Train O&M personnel in functional operations and procedures to be employed for system operation.

.2 Supplement with on-the-job training during 30 day test period.

.3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.

.4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

.3 Phase 2: Five day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.

.1 Provide multiple instructors on pre-arranged schedule. Include at least following:

.1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.

.2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.

.1 Programmers: provide personnel with 2 days training within 5 day period in following subjects in approximate percentages of total course shown:

- .1 Software and architecture: 10%
- .2 Application programs: 15%
- .3 Controller programming: 50%
- .4 Trouble shooting and debugging: 10%
- .5 Colour graphic generation: 15%.

1.9 ADDITIONAL TRAINING

.1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 MONITORING OF TRAINING

.1 Departmental Representative to monitor training program and may modify schedule and content.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Division 1.

.2 Section 23 05 00 – Common Work Results for HVAC

.3 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.4 Section 25 05 54 - EMCS: Identification.

.5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 SCOPE

.1 Provide controls for the replaced components of the heating system. Connect to and integrate with the existing Delta Control System (provided by ESC Controls), and the system graphics and operator work station.

.2 Note the phased nature of the project, and the requirement to maintain the heating system operational throughout the upgrade project, with minimized system interruptions. The facility remains operational throughout the duration of the project, and the operation and access for the staff and general public need to be maintained uninterrupted, and as normal as possible.

.3 All controls shall be electric and electronic. Pneumatic controls or actuation shall not be used.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).

.1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.

.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.

.3 Canadian Standards Association (CSA International).

.1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.

.4 Consumer Electronics Association (CEA).

.1 CEA-709.1-B-2002, Control Network Protocol Specification.

.5 Department of Justice Canada (Jus).

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.6 Electrical and Electronic Manufacturers Association (EEMAC).

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

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

.1 Material Safety Data Sheets (MSDS).

.8 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.4 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in EMCS:

.1 AEL - Average Effectiveness Level.
.2 AI - Analog Input.
.3 AIT - Agreement on International Trade.
.4 AO - Analog Output.
.5 BACnet - Building Automation and Control Network.
.6 BC(s) - Building Controller(s).
.7 BECC - Building Environmental Control Center.
.8 CAD - Computer Aided Design.
.9 CDL - Control Description Logic.
.10 CDS - Control Design Schematic.
.11 COSV - Change of State or Value.
.12 CPU - Central Processing Unit.
.13 DI - Digital Input.
.14 DO - Digital Output.
.15 DP - Differential Pressure.
.16 ECU - Equipment Control Unit.
.17 EMCS - Energy Monitoring and Control System.
.18 HVAC - Heating, Ventilation, Air Conditioning.
.19 IDE - Interface Device Equipment.
.20 I/O - Input/Output.
.21 ISA - Industry Standard Architecture.

.22 LAN - Local Area Network.
.23 LCU - Local Control Unit.
.24 MCU - Master Control Unit.
.25 NAFTA - North American Free Trade Agreement.
.26 NC - Normally Closed.
.27 NO - Normally Open.
.28 OS - Operating System.
.29 O&M - Operation and Maintenance.
.30 OWS - Operator Work Station.
.31 PC - Personal Computer.
.32 PCI - Peripheral Control Interface.
.33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
.34 PID - Proportional, Integral and Derivative.
.35 RAM - Random Access Memory.
.36 SP - Static Pressure.
.37 ROM - Read Only Memory.
.38 TCU - Terminal Control Unit.
.39 USB - Universal Serial Bus.
.40 UPS - Uninterruptible Power Supply.
.41 VAV - Variable Air Volume.

1.5 DEFINITIONS

.1 Point: may be logical or physical.

.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

.2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.2 Point Name: composed of two parts, point identifier and point expansion.

.1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.

.1 Area descriptor: building or part of building where point is located.

.2 System descriptor: system that point is located on.

.3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.

.2 Point expansion : comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.

.3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.

.1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

.3 Point Object Type: points fall into following object types:

.1 AI (analog input).

.2 AO (analog output).

.3 DI (digital input).

.4 DO (digital output).

.5 Pulse inputs.

.4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.

.1 Printouts: to ANSI/IEEE 260.1.

.2 Refer also to Section 25 05 54 - EMCS: Identification.

1.6 SYSTEM DESCRIPTION

.1 Control system shall be BACnet, and connect into and integrate with and connect into the existing facility control system..

.2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:

.1 Building Controllers.

.2 Control devices as listed in I/O point summary tables.

.3 OWS(s).

.4 Data communications equipment necessary to effect EMCS data transmission system.

.5 Field control devices.

.6 Software/Hardware complete with full documentation.

.7 Complete operating and maintenance manuals.

.8 Training of personnel.

.9 Acceptance tests, technical support during commissioning, full documentation.

.10 Wiring interface co-ordination of equipment supplied by others.

.11 Miscellaneous work as specified in these sections and as indicated.

.3 Design Requirements:

.1 Design and provide conduit and wiring linking elements of system.

.2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.

.3 Location of controllers as reviewed by Departmental Representative prior to installation.

.4 Provide utility power to EMCS and emergency power to EMCS as indicated.

.5 Metric references: in accordance with CAN/CSA Z234.1.

.4 Language Operating Requirements:

.1 Provide English operator selectable access codes.

.2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English and French.

.3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English and or French.

.4 System manager software: include in English and or French system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.

.5 Include, in English and French:

.1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French and English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.7 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Shop Drawings and Product Data Samples and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Co-ordinate submittal requirements and provide submittals required by

.3 Submit for review:

.1 Equipment list and systems manufacturers at time of bid tender within 48 h within 10 days after award of contract.

.2 List existing field control devices to be re-used included in bid tender, along with unit price.

.4 Quality Control:

.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.6 Permits and fees: in accordance with general conditions of contract.

.7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.

.8 Existing devices intended for re-use: submit test report.

1.8 QUALITY ASSURANCE

.1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,

.2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.

.3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.

.4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

.5 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

.3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan.

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

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.

.7 Label location of salvaged material's storage areas and provide barriers and security devices.

.8 Ensure emptied containers are sealed and stored safely.

.9 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

.10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.10 EXISTING CONDITIONS - CONTROL COMPONENTS

.1 Utilize existing control wiring and piping as practical. Provide new and replacement control wiring and piping as required.
Note: generally, the boiler and primary loops are expected to receive new sensors and instrumentation , whereas the secondary loops (at air handling units, etc) outside the boiler room may retain existing sensors and instrumentation.

.2 Where existing instrumentation, required for the controls is removed as part of the work, new instrumentation shall be re-installed in functionally comparable and adequate location, and its operation reinstated. Remit existing removed instrumentation to the Owner. When acceptable to the Departmental Representative, and acceptable to the Departmental Representative, re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.

.1 Do not modify original design of existing devices without written permission from Departmental Representative.

.2 Provide for new, properly designed device where re-usability of components is uncertain.

.3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.

.1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.

.2 Failure to produce test report will constitute acceptance of existing devices by contractor.

.4 Non-functioning items:

.1 Provide with report specification sheets or written functional requirements to support findings.

.2 Departmental Representative will repair or replace existing items, which are outside the scope of this work, judged defective yet deemed necessary for EMCS.

.5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

.6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.

.1 Be responsible for items repaired or replaced by Departmental Representative.

.2 Be responsible for repair costs due to negligence or abuse of equipment.

.3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative.

.7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

Part 2 Products

2.1 EQUIPMENT

.1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 ASHRAE STD 135, and compatible with existing EMCS System.

.2 Complete list of equipment and materials to be used on project and forming part of bid tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

2.2 ADAPTORS

.1 Provide adaptors between metric and imperial components.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 PAINTING

.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.

.3 Clean and prime exposed hangers, racks, fastenings, and other support components.

.4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

.2 Related Sections.

.1 Section 01 33 00 - Shop Drawings and Product Data Samples.

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.

.1 Location of local office.

.2 Description and location of installing and servicing technical staff.

.3 Location and qualifications of programming design and programming support staff.

.4 List of spare parts.

.5 Location of spare parts stock.

.6 Names of sub-contractors and site-specific key personnel.

.7 Sketch of site-specific system architecture.

.8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.

.9 Descriptive brochures.

.10 Sample CDL and graphics (systems schematics).

.11 Response time for each type of command and report.

.12 Item-by-item statement of compliance.

.13 Proof of demonstrated ability of system to communicate utilizing Proprietary Communications Protocol to communicate existing PDC control system.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Shop Drawings and Product Data Samples and coordinate with requirements in this Section.

.2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by Departmental Representative.

.3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.

.4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

.5 Soft copy to be in Autocad - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.5 PRELIMINARY SHOP DRAWING REVIEW

.1 Submit preliminary shop drawings within 30 working days of award of contract and include following:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.

.2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.

.3 Spare point capacity of each controller by number and type.

.4 Controller locations.

.5 Auxiliary control cabinet locations.

.6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

.7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

.8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

.9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

.10 Compressor schematic and sizing data.

1.6 DETAIL SHOP DRAWING REVIEW

.1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:

.1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.

.2 Wiring diagrams.

.3 Piping diagrams and hook-ups.

.4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.

.5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:

.1 Sensing element type and location.

.2 Transmitter type and range.

.3 Associated field wiring schematics, schedules and terminations.

.4 Complete Point Name Lists.

.5 Set-points, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.

.6 Software and programming details associated with each point.

.7 Manufacturer's recommended installation instructions and procedures.

.8 Input and output signal levels or pressures where new system ties into existing control equipment.

.6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.

.7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.

.8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.

.9 Listing and example of specified reports.

.10 Listing of time of day schedules.

.11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.

.12 Type and size of memory with statement of spare memory capacity.

.13 Full description of software programs provided.

.14 Sample of "Operating Instructions Manual" to be used for training purposes.

.15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 QUALITY ASSURANCE

.1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:

.1 Undertake functional review of preliminary design documents, resolve inconsistencies.

.2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations."

.2 Contractor's programmer to attend meeting.

.3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.

.2 Related Sections.

.1 Section 01 78 00 - Shop Drawings and Product Data Samples.
.2 Section 23 05 00 - Common Work Results for HVAC
.3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
.4 Section 23 08 00 - Commissioning - Mechanical Systems
.5 Section 25 05 01 - EMCS: General Requirements.
.6 Section 25 05 02 - EMCS: Submittals and Review Process.
.7 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 OWS - Operator Work Station.

.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.

.2 Submit As-built drawings and Operation and Maintenance Manual to Departmental Representative in English and French.

.3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.

.1 Binders to be 2/3 maximum full.
.2 Provide index to full volume in each binder.
.3 Identify contents of each manual on cover and spine.
.4 Provide Table of Contents in each manual.
.5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

.1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:

- .1 Changes to contract documents as well as addenda and contract extras.
- .2 Changes to interface wiring.
- .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
- .4 Locations of obscure devices to be indicated on drawings.
- .5 Listing of alarm messages.
- .6 Panel/circuit breaker number for sources of normal/emergency power.
- .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
- .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .9 Basic system design and full documentation on system configuration.

.2 Submit for final review by Departmental Representative.

.3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.5 O&M MANUALS

.1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:

- .1 Functional description of theory of operation.
- .2 Design philosophy.
- .3 Specific functions of design philosophy and system.
- .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
- .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.

.6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.

.5 System operation to include:

.1 Complete step-by-step procedures for operation of system including required actions at each OWS.

.2 Operation of computer peripherals, input and output formats.

.3 Emergency, alarm and failure recovery.

.4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.6 Software to include:

.1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.

.2 Detailed descriptions of program requirements and capabilities.

.3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.

.4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device

.5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.

.6 Software for each Controller and single section referencing Controller common parameters and functions.

.7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

.8 System configuration document:

.1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.

.2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

.9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

.2 Maintain the existing system and existing facility standard.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Shop Drawings and Product Data Samples.

.2 Section 23 05 00 - Common Work Results for HVAC

.3 Section 23 08 00 - Commissioning - Mechanical Systems

.4 Section 25 05 01 - EMCS: General Requirements.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.4 DEFINITIONS

.1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.5 SYSTEM DESCRIPTION

.1 Maintain the existing system and existing facility standard.

.2 Language Operating Requirements: provide identification for control items in English.

1.6 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Shop Drawings and Product Data Samples supplemented and modified by requirements of this Section.

.2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by chain plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include: point name and point address.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels using point identifier.

.2 Location: as directed by Departmental Representative.

.3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative.

2.5 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

.1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for building automation controllers including:

.1 Master Control Unit (MCU).

.2 Local Control Unit (LCU).

.3 Equipment Control Unit (ECU).

.4 Terminal Control Unit (TCU).

.2 Related Sections:

.1 Section 25 05 01 - EMCS: General Requirements.

.2 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.3 Section 25 05 03 - EMCS: Project Record Documents.

.4 Section 25 30 02 - EMCS: Field Control Devices.

.5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).

.1 ASHRAE 2003, Applications Handbook, SI Edition.

.2 Canadian Standards Association (CSA International).

.1 C22.2 No.205-M1983(R1999), Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE).

.1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

.4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.

.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English:
Note: confirm latest edition with the Owner.

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

.1 EMCS - Building Automation System, same as BAS

.2 SAP - Stand Alone Panel - generic term that applies to BC, AAC, ASC

.3 DI - Digital Input

.4 DO - Digital Output
.5 AI - Analog Input
.6 AO - Analog Output
.7 HVAC - Heating, Ventilation, Air Conditioning
.8 MCC - Motor Control Center
.9 DDC - Direct Digital Control
.10 LAN - Local Area Network
.11 OS - Operating System
.12 OT - Operator Terminal
.13 PC - Personal Computer
.14 OWS - BACnet Operator Work Station – same as B-OWS
.15 Native - Native BACnet
.16 BC - BACnet Building Controller – same as B-BC
.17 AAC - BACnet Custom Application Controller - same as B-AAC
.18 ASC - BACnet Application Specific Controller - same as B-ASC
.19 SS - BACnet Smart Sensor – same as B-SS Ethernet – BACnet TCP/IP Ethernet
.20 MS/TP - BACnet Master-Slave/Token Passing
.21 PTP - BACnet Point–to-Point Protocol
.22 Gateway - BACnet Gateway
.23 Micropanel Generic term that applies to AAC and ASC

1.4 SCOPE OF WORK

.1 The control system must be compatible with, be connected to, be an extension of and be integrated with the existing (Reliable Controls System) Building Automation System installed in the existing facility. The new functions shall be monitored, controlled and programmed from the existing facility.

.2 Include for the controllers and programming required to incorporate the new functions and the new system into the existing system and graphics.

.3 Review and adjust existing sequences to follow energy efficient strategies.

.4 Review and adjust existing sequences to ensure the same components (such as dual duct boxes or multizone units) are controlled with the same code, and same sequences.

.5 All components, programming and interface shall maintain the facility standard.

.6 Supply, installation and mounting of all hardware (unless specifically stated otherwise).

.7 Supply and mounting of sensor elements and associated hardware, wiring or piping connecting sensors to SAPs.

.8 Wiring connecting SAPs to transducers, fire alarm and smoke control.

.9 Supply and wiring connection of solid state relays and relays to terminal connections at MCCs and to SAPs.

.10 Supply and installation of SAPs comprising of BCs, AACs, and ASCs;

.11 The controls sub-contractor will do the complete installation of all sensors, associated control panels, relays, transducers, actuators, flow switches, gauges, air receivers, SAP computer board, associated power supplies, conduit, wiring, tubing, and all other control devices including isolation room panels, and all terminations.

.12 The controls sub-contractor will participate and provide coordination required between the Client, the Consultant, other sub-contractors where controls are involved and the commissioning agent.

.13 The controls sub-contractor will provide verification and commissioning as follows:

.1 End to end continuity checks will be performed on all wiring and control tubing.

.2 All sensors, transducers, relays, actuators, control valves and dampers will be calibrated and operationally checked by this Sub-Contractor.

.3 Provide a point checkout sheet for verification of system. This Sub-Contractor to initial each point as it is verified.

.14 The controls sub-contractor will test the SAP computer hardware and operator consoles.

1.5 SOFTWARE UPDATE

.1 Patches to the software package shall be provided at no cost for the lifetime of the system. These shall include all patches and fixes to the original software package supplied, but shall not necessarily include new software products subsequently released by the manufacturer after substantial completion.

1.6 SYSTEM DESCRIPTION

.1 A complete, fully tested, commissioned and operational Native BACnet Building Automation System (EMCS) utilizing fully electronic Direct Digital Control (DDC) to meet the requirements described herein and in complete accordance with applicable codes and ordinances.

.2 The system software and control devices shall be fully compatible with the existing ESC Automation/Delta System programs and hardware, latest BACnet versions.

.3 Unless specified otherwise, provide proportional plus integral electronic components.

.4 The design, installation, supervision and labor services, calibration, software programming and de-bugging, checkout and commissioning required for the EMCS.

.5 Supply and installation of electronic packaged zone controllers for terminal unit control.

.6 Devices, components, wiring and materials as required for a fully operating control system.

.7 Include full graphics operating package with modification of existing site graphics and navigation sequences via customized software programming.

.8 Instruction to the Facility's maintenance and operating personnel.

.9 Complete system documentation including:

.1 As-built site diagrams showing location of wiring and panels and system architecture.

.2 Operating and Maintenance manuals.

1.7 DESIGN REQUIREMENTS

.1 To include:

.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.

.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.

.4 Control of systems as described in sequence of operations.

.5 Execution of optimization routines as listed in this section.

.2 Total spare capacity for MCUs and LCUs: at least [25] % of each point type distributed throughout the MCUs and LCUs.

.3 Field Termination and Interface Devices:

.1 To: CSA C22.2 No.205.

.2 Electronically interface sensors and control devices to processor unit.

.3 Include, but not be limited to, following:

.1 Programmed firmware or logic circuits to meet functional and technical requirements.

.2 Power supplies for operation of logics devices and associated field equipment.

.3 Lockable wall cabinet.

.4 Required communications equipment and wiring (if remote units).

.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.

.7 Wiring terminations: use conveniently located screw type or spade lug terminals.

.4 AI interface equipment to:

.1 Convert analog signals to digital format with [10] bit analog-to-digital resolution.

.2 Provide for following input signal types and ranges:

.1 [4 - 20] mA;

.2 [0 - 10] V DC;

.3 100/1000 ohm RTD input;

.3 Meet IEEE C37.90.1 surge withstand capability.

.4 Have common mode signal rejection greater than [60] dB to [60] Hz.

.5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

.5 AO interface equipment:

.1 Convert digital data from controller processor to acceptable analog output signals using [8] bit digital-to-analog resolution.

.2 Provide for following output signal types and ranges:

.1 [4 - 20] mA.

.2 [0 - 10] V DC.

.3 Meet IEEE C37.90.1 surge withstand capability.

.6 DI interface equipment:

.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.

.2 Meet IEEE C37.90.1 surge withstand capability.

.3 Accept pulsed inputs up to [2] kHz.

.7 DO interface equipment:

.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to [0.5] amps at [24] V AC.

.2 Switch up to [5] amps at [220] V AC using optional interface relay.

.4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

.5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.

.1 Provide for conduit entrance from top, bottom or sides of panel.

.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.

.3 Mounting details as approved by Departmental Representative for ceiling mounting.

.6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.7 Provide surge and low voltage protection for interconnecting wiring connections.

1.8 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process .

.1 Submit product data sheets for each product item proposed for this project.

1.9 MAINTENANCE PROCEDURES

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents .

Part 2 Products

2.1 CABLE

.1 Primary Data transmission cable shall be CAT 5 Ethernet cable

2.2 ELECTRONIC TERMINAL EQUIPMENT (AAC) CONTROLLERS

.1 Each zone controller will be microprocessor-based, multi-tasking, real-time digital control processor. The zone controllers will monitor space temperature sensors and control operation of terminal air valves, air valve reheat coils, fan coil units, and perimeter radiant panels in the corresponding zone.

.2 Each zone controller will have sufficient memory to support its own operating system and data base including:

.1 Control functions.

.2 Energy management applications.

.3 Interface with operator portable personal computer.

.3 Zone controller panels will have the following features:

.1 Set-point adjustments.

.2 Modify gain and offset constants.

.3 Program parameter adjustments.

.4 Trend log display edit/create trend logs through DDC system main panels.

.4 Zone controllers shall NOT be mounted in ceiling spaces.

2.3 ELECTRONIC AIR VALVE CONTROLS, SENSORS & ACTUATORS

.1 Control sub-contractor shall include for the supply and installation of pressure sensors, operators and stand-alone controllers for the air valves.

.2 Control components shall be pre-assembled for testing and performance verification prior to arrival on site.

.3 Multipoint crossflow sensors shall be supplied by air valve manufacturer.

.4 Flow transducer shall be a full differential pressure unit not hot wire or thermistor type.

.5 Electronic operators shall be provided for air valve dampers with piston or gear driven type damper operators.

.6 Air valve damper motors shall be Belimo LM24-T floating control or approved equal.

.7 Damper operators shall operate with floating point signal for full modulation.

.8 Damper operators shall be rigidly attached to the support structure and linkage shall have no "slop."

.9 These control components shall be field tested with air valve for testing and performance verification.

.10 Submit written test data for the terminal unit controllers for each size of air valve and fan coil unit.

.11 Supply air temperature measurement shall be provided on each air valve with reheat coils.

2.4 DDC SYSTEM FUNCTIONS

.1 The DDC system shall utilize "BACnet open architecture" and have a proven Operator Control Language (OCL), which shall be capable of reading the value, and/or status of all control devices from any user defined combination of calculations and logical expressions.

.2 All SAP's and BACnet Gateways shall conform to the BACnet Protocol Implementation Conformance Specification.

.3 Other mandatory monitoring and control features of the DDC system are:

.1 Provide two level security system access with passwords.

.1 Level 1: to allow assignment of Level 1 and Level 2 passwords. Creation of new system operators, ability to create, delete and modify system components, modify selected system components, and alarm levels, and generally full system access.

.2 Level 2: to allow command and override of system components, alarm acknowledgment, monitor system, display information including alarm messages, graphics, points log, help menus.

.2 Operator defined digital and analog alarms and automatic alarm condition reporting.

.3 Auto lockout of alarms when alarmed system is shut down.

.4 Direct keyboard override of all digital and analog outputs, with an indication of the display of any point that is operating under keyboard override.

.5 Addition, deletion, definition and modification of points and point types from operator keyboard.

.6 Trend log graphing of user selected points and times.

.7 Run time totalization.

.4 The DDC system shall have the capability to be taken off line in the event of failure or for maintenance and returned to operation without the need for entering any portion of the software program manually. To accomplish this, an off-line disk storage device shall be utilized to provide software backup and reload.

.5 On-site backup and verification of the entire system, with full applications software, shall be less than TEN (10) seconds per SAP.

.6 The DDC system shall be provided with automatic protection from any power failure of up to seventy two (72) hours duration.

.7 This protection shall at a minimum include continuous real-time clock operation and automatic system restart upon power return. System will be tested to confirm rated hours.

.8 Panel replacement shall be possible without any hardware modification. Describe replacement procedure in technical data submitted.

.9 Any panel malfunction shall not affect the operation of the multi-panel system.

.10 Indicate how points located on one panel can be accessed and utilized by another panel. Explain any limitations of the above.

.11 Each BC and AAC standard panel proposed shall have enough random access memory for all of the following:

.1 Trend Logs - two for each input and output point connected to the panel with 100 samples each.

.2 Controllers - two for each analog output point connected to the panel.

.3 Variables - three for each output point connected to the panel. Variables are "virtual points" (as opposed to physical points) but which have all the attributes of real or physical points.

.4 Operator Control Language (OCCL) - twenty syntactically correct lines each with at least 4 operators, for each output point connected to the panel, or TEN (10) syntactically correct lines, each with at least four operators, for each output point connected to the panel, if the OCL has the ability to call common routines or use wild card commands.

.5 Descriptor - one for each user definable point, real or virtual, in the panel. In addition, on multi-panel systems, every descriptor in the system must be accessible from a single I/O port.

.6 Time Schedules - one for every 3 output points connected to the panel.

.7 Totalizers - one for each digital point in the panel.

.12 Processing Speed

.1 Effective Panel Processing Speed - Maximum permissible execution time is half a second. Execution time is defined as the time it takes the stand alone panel CPU

to execute all application software in the panel, from some point in the software back to the same point, assuming full memory usage, while simultaneously responding to operator or terminal display requests and carrying out normal inter-panel communications averaged over a one - minute period. This will be done by setting up a counter in each panel and monitoring the counting rate.

.2 Effective System Processing Speed - This applies to multi-panel systems only. System processing speed is intended to address inter-panel communication and will be checked by evaluating system display response. This will be done by setting up a display of all panel counters and checking how frequently each counter updated on the refreshed display.

.3 Displays shall load real time current values, not stored values, within ten seconds. Every counter shall show an updated value on the display within sixty seconds at the previous update appearing. Provide confirmation that required system processing speed will be achieved.

.13 DDC System Inter-Panel Communication.

.1 Means shall be provided to ensure communication integrity. Provide detail of the system.

.2 To prevent damage to the system, each data highway line shall be provided with a means of isolation, either optically or by some other means. Provide detail of protection system in proposal.

.14 Sensors and Associated Equipment.

.1 EMCS shall be supplied with all sensors, relays and associated equipment to fully connect the listed DDC points. Field point installation shall be performed in a neat and orderly fashion with all components marked or labeled to correspond with the making or labeling in the as built drawings.

.2 All sensors and controllers shall be of commercial grade and shall be installed according to the manufacturer's recommendations. Provide full details of all sensors and controllers proposed, including their range and accuracy.

2.5 SYSTEM STRUCTURE

.1 The Building Automation System (EMCS) architecture shall consist of the following installed in communication and main mechanical rooms:

.1 Stand-alone DDC system main panels

.2 Stand-alone DDC system terminal equipment (zone) controllers

.3 Provide plug-in access for remote or lap-top computer at each panel using the same software as resides on the central workstation.

2.6 DDC SYSTEM PANELS

.1 References:

.1 National Institute of Standards and Technology - NISTIR 6392 GSA Guide to Specifying Interoperable Building Automation and Control Systems Using ANSI/ASHRAE Standard 135-1995, BACnet.

.2 DDC Panel Types:

.1 BC minimum capabilities equivalent to the BACnet Building Controller (B-BC).

.2 AAC Local Control Unit minimum capabilities equivalent to the BACnet Custom Application Specific Controller (B-AAC).

.3 ASC Terminal Control Unit minimum capabilities equivalent to the BACnet Application Specific (B-ASC).

.4 AAC Room Control Unit minimum capabilities equivalent to the BACnet Custom Application Specific Controller (B-AAC).

.5 SS Smart Sensor minimum capabilities equivalent to the BACnet Smart Sensor (B-SS).

.3 DDC Panel Applications – This section describes the mechanical systems that shall be connected to the different DDC panel types.

.1 BC main function is to provide direct control of all main central mechanical systems such as chillers, cooling towers, heat exchangers, domestic hot water, fan systems etc. The BC's shall directly reside on the primary Ethernet LAN.

.2 AAC function is to provide control for miscellaneous HVAC components in remote mechanical rooms such as rooftop units, fan coils, unit ventilators, VAV, etc. AAC's shall reside on the secondary RS485 MS/TP network.

.3 ASC level controllers are not acceptable unless specifically specified for a unique application.

.4 All DDC panels shall meet the minimum requirements set out in this section.

2.7 BC BACnet OVERVIEW

.1 A BC (B-BC) is a native BACnet, general purpose, field programmable controller capable of carrying out a variety of building automation and control tasks. It enables the specification of the following:

.1 Data Sharing:

.1 Ability to provide the values of any of its BACnet objects.

.2 Ability to retrieve the values of BACnet objects from other devices.

.3 Ability to allow modification of all of its BACnet objects by another device.

.2 Alarm and Event Management:

.1 Generation of alarm / event notifications and the ability to direct them to recipients.

.2 Maintain a list of unacknowledged alarms / events.

.3 Notification of other recipients that the acknowledgment has been received.

.4 Adjustment of alarm / event parameters.

.3 Scheduling:

.1 Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.

.4 Trending:

.1 Collection and delivery of (time, value) pairs.

.5 Device and Network Management:

.1 Ability to respond to information about its status.

.2 Ability to respond to requests for information about any of its objects.

.3 Ability to respond to communication control messages.

.4 Ability to synchronize its internal clock upon request.

.5 Ability to perform re-initialization upon request.

.6 Ability to upload its configuration and allow it to be subsequently restored.

.7 Ability to command half-routers to establish and terminate connections.

.2 Provide sufficient number of BC's to fully meet all requirements of this specification plus specified spare point capacity. An Ethernet gateway connecting the WAN to the building BC is NOT acceptable.

.3 BC to be stand-alone intelligent controller. BC panel to:

.1 Be microprocessor based, multi-tasking, multi-user, real-time digital control processors capable of supervising other lower level programmable controllers through secondary networks.

.2 Consist of modular hardware with plug-in processors, communication controllers, power supplies, I/O modules.

.3 Provide MS/TP BACnet LAN port for local AAC/ASC network.

.4 Provide on board LAN interface for ethernet BACnet peer-to-peer communication between BC’s and at least [1] RS-232C serial data communication ports to support simultaneous operation of multiple operator I/O devices such as industry standard printers, lap-top work-stations, PC work-stations and BC-mounted or portable OTs. One RS-232C data port will support point-to-point PTP BACnet protocol.

.5 Allow temporary use of portable devices without interrupting normal operation of permanently connected modems, printers, OTs.

.6 Interface field sensors via local I/O terminations located on BC located in processor cabinet.

.7 In standalone mode execute programmable logic control (direct digital or closed loop process control) of associated HVAC equipment without interacting with other processors or OWSs.

.4 Dial-up Communications:

.1 Auto-dial/auto-answer communications to allow BCs to communicate with remote OW’s on non-continuous basis via telephone lines. Or Internet IP communications link to communicate with network

.2 To analyze and set priorities for all alarms to minimize of calls. Non-critical alarms to be buffered in memory and reported as group or until operator manually requests upload of alarms.

.5 Spare Capacity:

.1 Provide 20% spare point capacity on panels with greater than 32 I/O and 10% spare capacity on panels with less than 32 I/O.

.6 Programming and Energy management routines:

.1 BC to provide for the following energy management routines:

.1 Time of day scheduling.
.2 Calendar based scheduling.
.3 Holiday scheduling.
.4 Temporary schedule overrides.
.5 Optimal start.
.6 Optimal stop.
.7 Supply air reset
.8 Duty cycling
.9 Night setback
.10 Chilled water and condensor water reset
.11 Heating water reset

.7 All programs to be executed automatically without need for operator intervention.

.8 Programming languages:

.1 Shall meet requirements specified in Custom Programming Capability section of specification.

.9 Priority Level:

.1 BC shall provide for 16 levels of priority from all outputs. The priority levels shall conform to the BACnet object specifications.

.10 Trend Logging:

.1 All trend log information shall be stored at BC and not at OWS.

2.8 AAC BACnet OVERVIEW

.1 An AAC (B-AAC) is a general purpose, field programmable controller capable of carrying out a variety of building automation and control tasks. It enables the specification of the following:

.1 Data Sharing:

.1 Ability to provide the values of any of its BACnet objects.
.2 Ability to retrieve the values of BACnet objects from other devices.
.3 Ability to allow modification of all of its BACnet objects by another device.

.2 Alarm and Event Management:

.1 Generation of alarm / event notifications and the ability to direct them to recipients.

.2 Maintain a list of unacknowledged alarms / events.

.3 Notifying other recipients that the acknowledgment has been received.

.4 Adjustment of alarm / event parameters.

.3 Scheduling:

.1 Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.

.4 Trending:

.1 Collection and delivery of (time, value) pairs.

.5 Device and Network Management:

.1 Ability to respond to information about its status.

.2 Ability to respond to requests for information about any of its objects.

.3 Ability to respond to communication control messages.

.4 Ability to synchronize its internal clock upon request.

.5 Ability to perform re-initialization upon request.

.6 Ability to upload its configuration and allow it to be subsequently restored.

.7 Ability to command half-routers to establish and terminate connections.

.2 Provide sufficient number of AAC's to fully meet all requirements of this specification plus specified spare point capacity.

.3 AAC to be stand-alone intelligent controller. AAC panel to:

.1 Be microprocessor based, multi-tasking, multi-user, real-time digital control processors capable of supervising other lower level programmable controllers through secondary networks.

.2 Consist of modular hardware with plug-in processors, communication controllers, power supplies, I/O modules.

.4 Provide MS/TP BACnet LAN port for local ASC network.

.5 Provide on board LAN interface for MS/TP BACnet peer-to-peer communication between AAC’s and at least [1] RS-232C serial data communication port to support operation of operator I/O devices such as industry standard printers, lap-top work-stations, PC work-stations and AAC-mounted or portable OTs. RS-232C data port, will support point to point PTP BACnet protocol.

.6 Allow temporary use of portable devices without interrupting normal operation of permanently connected modems, printers, OTs.

.7 Interface field sensors directly to I/O terminations located on AAC in processor cabinet.

.8 In standalone mode execute programmable logic control (direct digital or closed loop process control) of associated HVAC equipment without interacting with other processors or OWSs.

.9 Spare Capacity:

.1 Provide 10% spare point capacity for each AAC without additional cards, terminals or a minimum of one spare input and one spare output.

.2 If AAC is used for unitary equipment then no spare capacity is required unless identified on points list.

.10 Programming and Energy management routines:

.1 AAC to provide for the following energy management routines:

.1 Time of day scheduling.

.2 Calendar based scheduling.

.3 Holiday scheduling.

.4 Temporary schedule overrides.

.5 Optimal start.

.6 Optimal stop.

.7 Supply air reset.

.8 Duty cycling.

.9 Night setback.

.11 All programs to be executed automatically without need for operator intervention.

.12 Programming languages:

.1 Shall meet requirements specified in Custom Programming Capability section of specification.

.13 Priority Level:

.1 AAC shall provide for 16 levels of priority from all outputs. The priority levels shall conform to the BACnet object specifications.

.14 Trend Logging:

.1 All trend log information shall be stored at AAC and not at BC or OWS.

2.9 ASC BACnet OVERVIEW

.1 ASC BACnet overview: An ASC (B-ASC) is a controller with limited resources relative to an AAC. It is intended for use in a specific application and supports limited programmability. It enables specification of the following:

.1 Data Sharing:

.1 Ability to provide the values of any of its BACnet objects.

.2 Ability to allow modification of some or all of its BACnet objects by another device.

.2 Alarm and Event Management:

.1 None.

.3 Scheduling

.1 None.

.4 Trending

.1 None.

.5 Device and Network Management

.1 Ability to respond to information about its status.

.2 ASC to be stand-alone intelligent controller. ASC panel to:

.1 Be microprocessor based, real-time digital control processors.

.2 Consist of modular hardware with communication controllers, power supplies, I/O modules.

.3 Provide on board LAN interface for MS/TP BACnet peer-to-peer communication between ASC's and at least [1] RS-232C serial data communication port to support operation of operator I/O devices such as industry standard printers, lap-top work-stations, PC work-stations and ASC-mounted or portable OTs.

.4 Allow temporary use of portable devices without interrupting normal operation of permanently connected modems, printers, OTs.

.5 Interface field sensors directly to I/O terminations located on ASC in processor cabinet.

.3 In standalone mode execute programmable logic control (direct digital or closed loop process control) of associated terminal equipment without interacting with other processors or OWSs.

.4 Spare Capacity:

.1 Provide 10% spare point capacity for each ASC without additional cards, terminals.

.2 If ASC is used for terminal equipment then no spare capacity is required unless identified on points list.

.5 Programming and Energy management routines:

.1 ASC to provide for the following energy management routines:

.1 Temporary schedule overrides.

.2 Supply air reset.

.3 Night setback.

.2 All programs to be executed automatically without need for operator intervention.

.3 Programming languages:

.1 Firmware based application specific program utilizing full BACnet objects and functionality.

.6 Priority Level:

.1 ASC shall provide for 1 levels of priority from all outputs.

.7 Trend Logging

.1 All trend log information shall be stored at AAC or BC not ASC.

2.10 CUSTOM PROGRAMMING CAPABILITY

.1 Programming languages:

.1 All GCL General Control Language software to be programmed in general control type or high-level control language supporting full BACnet objects and functionality.

Part 3 Execution

3.1 LOCATION

.1 Location of Controllers to be approved by Departmental Representative.

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures and as directed by Departmental Representative.

.2 Provide necessary power from local [120] V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

.4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Control devices integral to the Building Energy Monitoring and Control System (EMCS), also referred to as a Building Automation System (BAS): transmitters, sensors, controls, meters, switches, transducers, valves, valve actuators, and low voltage current transformers.

.2 Related Sections:

.3 Section 25 05 01 - EMCS: General Requirements.

.4 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.5 Section 25 05 03 - EMCS: Project Record Documents.

.6 Section 25 30 01 - EMCS: Building Controllers.

.7 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

.8 Section 26 05 00 - Common Work Results (for Electrical).

1.2 REFERENCES

.1 American National Standards Institute (ANSI).

.1 ANSI C12.7-1993(R1999), Requirements for Watt-hour Meter Sockets.

.2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA).

.1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Air Movement and Control Association, Inc. (AMCA).

.1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.

.5 Canadian Standards Association (CSA International).

.1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.

.2 Pre-Installation Tests.

.1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.

.3 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 EXISTING CONDITIONS

.1 Cutting and Patching: in accordance with Section 23 05 00, supplemented as specified herein.

.2 Repair surfaces damaged during execution of Work. Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight assembly.

.3 Operating conditions: [0] - [40] degrees C with [10] - [90]% RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA [4] enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of [35]. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE SENSORS

.1 General: except for room sensors to be resistance or thermocouple type to following requirements:

.1 Thermocouples: limit to temperature range of 200 degrees C and over.

.2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.

.3 Sensing element: hermetically sealed.

.4 Stem and tip construction: copper or type 304 stainless steel.

.5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.

.6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 150 mm as indicated.

2.3 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.

.2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.

.3 Output signal: 4 - 20 mA into500 ohm maximum load.

.4 Input and output short circuit and open circuit protection.

.5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.

.7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 degrees C.

.10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.

.11 Transmitter ranges: select narrowest range to suit application from following:

.1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.

.2 0 to 100 degrees C, plus or minus 0.5 degrees C.

.3 0 to 250 degrees C, plus or minus 0.5 degrees C..

2.4 PRESSURE TRANSDUCERS

.1 Requirements:

.1 Combined sensor and transmitter measuring pressure.

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

.6 Over-pressure input protection to at least twice rated input pressure.

.7 Output short circuit and open circuit protection.

.8 Accuracy: plus or minus 1 % of Full Scale.

2.5 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:

.1 Internal materials: suitable for continuous contact with industrial standard or water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.6 STATIC PRESSURE SENSORS

.1 Requirements:

.1 Multipoint element with self-averaging manifold.

.1 Maximum pressure loss: [160] Pa at [10] m/s. (Air stream manifold).

.2 Accuracy: plus or minus [1] % of actual duct static pressure.

2.7 STATIC PRESSURE TRANSMITTERS

.1 Requirements:

.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.

.2 Calibrated span: not to exceed 150 % of pipe static pressure at maximum flow.

.3 Accuracy: 0.4 % of span.

.4 Repeatability: within 0.5 % of output.

.5 Linearity: within 1.5 % of span.

.6 Deadband or hysteresis: 0.1 % of span.

.7 External exposed zero and span adjustment.

.8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.8 LIQUID FLOW METERS

.1 Requirements:

.1 Pressure rating: as specified in I/O summaries.

.2 Temperature rating: as specified in I/O summaries.

.3 Repeatability: plus or minus 0.2 %.

.4 Accuracy and linearity: plus or minus 1.0 %.

.5 Flow rangability: at least 10:1.

.6 Body material.

.7 Twin turbine type.

.8 Ends:

.1 NPS 2 and under: screwed.

.2 NPS 2.1/2 and over: flanged.

2.9 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Requirements:

.1 Internal materials: suitable for continuous contact with water, steam, etc., as applicable.

.2 Adjustable setpoint and differential.

.3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.

.4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.

.5 Accuracy: within 2 % repetitive switching.

.6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.

.7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.10 TEMPERATURE SWITCHES

.1 Requirements:

.1 Operate automatically. Reset automatically, except as follows:

.1 Low temperature detection: manual reset.

.2 High temperature detection: manual reset.

.2 Adjustable setpoint and differential.

.3 Accuracy: plus or minus 1 degrees C.

.4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.

.5 Type as follows:

.1 Room: for wall mounting on standard electrical box with without protective guard as indicated.

.2 Duct, general purpose: insertion length = 460 mm.

.3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

.4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

.5 Strap-on: with helical screw stainless steel clamp.

2.11 CURRENT / PNEUMATIC (I/P) TRANSDUCERS

.1 Requirements:

.1 Input range: 4 to 20 mA.

.2 Output range: proportional 20-104 kPa or 20-186 kPa as applicable.

.3 Housing: dustproof or panel mounted.

.4 Internal materials: suitable for continuous contact with industrial standard instrument air.

.5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2 % of full scale over entire range.

.6 Integral zero and span adjustment.

.7 Temperature effect: plus or minus 2.0 % of full scale/ 50 degrees C or less.

.8 Regulated supply pressure: 206 kPa maximum.

.9 Air consumption: 16.5 ml/s maximum.

.10 Integral gauge manifold c/w gauge (0-206 kPa).

2.12 VARIABLE SPEED DRIVE (VARIABLE FREQUENCY DRIVE)

.1 Variable speed motor drive controllers have been specified to be provided as part of pumps packages, to be supplied by the mechanical contractor, wired and connected by Division 16 (Power Wiring) and control wiring by the controls sub-trade (under this contract). Refer to Division 23 for specified product information, etc.

2.13 CURRENT TRANSDUCERS

.1 Requirements:

.2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:

.1 4-20 mA DC.

.2 0-1 volt DC.

.3 0-10 volts DC.

.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.14 CURRENT SENSING RELAYS

.1 Requirements:

.1 Suitable to detect belt loss or motor failure.

.2 Trip point adjustment, output status LED.

.3 Split core for easy mounting.

.4 Induced sensor power.

.5 Relay contacts: capable of handling [0.5] amps at 30 VAC / DC. Output to be NO solid state.

.6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.

.7 Adjustable latch level.

2.15 CONTROL VALVES

.1 Body: globe style or ball type with characterizing disk, pressure and temperature rated to match system rating, suitable for the system operating and rated pressure.

.1 Flow characteristic as indicated on control valve schedule: linear, equal percentage, quick opening.

.2 Flow factor (CV in imperial units) as indicated on control valve schedule.

.3 Normally open or Normally closed, as indicated.

.4 Two or Three port (two or three way), as indicated.

.5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.

.6 Packing easily replaceable.

.7 Stem, stainless steel.

.8 Plug and seat, stainless steel.

.9 Disc, replaceable, material to suit application.

.10 NPS 2 and under:

.1 Screwed National Pipe Thread (NPT) tapered female connections.

.2 Valves to ANSI Class 250 , valves to bear ANSI mark.

.3 Rangeability 50:1 minimum.

.11 NPS 2 and larger:

.1 Flanged connections.

.2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.

.3 Rangeability 100:1 minimum.

2.16 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Control signal: 0-10V DC or 4-20 mA DC.

.3 Positioning time: to suit application. 90 sec maximum.

.4 Fail to normal position as indicated.

.5 Scale or dial indication of actual control valve position.

.6 Size actuator to meet requirements and performance of control valve specifications.

.7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.

.8 Minimum shut-off pressure: 2000 kPa [300 psi} unless otherwise noted.

.9 Position feedback.

2.17 ELECTRIC RELAYS (ER)

.1 Provide DPDT relays for control and status indication of alarms and/or electrical starters and equipment.

.2 Relay coils shall be rated for 120V or 24V. Where other voltages occur provide transformer.

.3 Contacts rated at 5 amps at 120V AC.

.4 Relays to be plug in type with termination base.

2.18 FLOW SWITCHES (FSW)

.1 Acceptable Manufacturers: McDonnell Miller, Johnson Controls.

.2 Minimum Requirements:

.1 Single pole double throw action (vapour proof on chilled water).

.2 Adjustable sensitivity.

.3 Extended trimmable paddles.

.4 Selected for minimum flow condition.

.3 Notes:

.1 Install in upright position in horizontal run of pipe.

.2 Install a minimum of 5 pipe diameters downstream of any valves, elbows, orifices or any other obstructions.

.3 Adhere to manufacturer's installation recommendations.

2.19 HUMIDITY SENSORS (HS)

.1 Provide humidity sensors as directed with the following minimum specifications:

.1 Range room type 30-80% RH.

.2 Range duct type 20-90% RH.

.3 Operating temperature range of 0°C to 60°C.

.4 Absolute accuracy of +/- 3% RH.

.5 Stainless steel sheath construction complete with integral shroud to enable specified operation in air streams of up to 10 m/sec.

.6 Sensor able to be cleansed of oil vapour, dust or other anticipated air borne contaminants by a simple field method such as solvent or mild detergent solution washing.

.7 Room humidity sensors shall be located at the inlet to an RA grille.

.8 Duct mounted sensors shall be located such that the sensing element is located in the air stream and the transmitter electronics are out of the air stream.

2.20 WIRING

.1 In accordance with Section 26 05 21 - Wiring and Cables.

.2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 Wiring must be continuous without joints.

.4 Sizes:

.1 Field wiring to digital device: #18AWG 20AWG stranded twisted pair.

.2 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, controllers, relays: install in NEMA 2 enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Fire stopping: provide space for fire stopping in accordance with Division 23. Maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results (for Electrical).

.2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.

.4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.5 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

.6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.2 TEMPERATURE AND HUMIDITY SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:

.1 Protect from solar radiation and wind effects by non-corroding shields.

.2 Install in NEMA 4 enclosures.

.3 Wire multiple sensors in series for low temperature protection applications.

.4 Wire multiple sensors separately for temperature measurement.

.5 Use software averaging algorithm to derive overall average for control purposes.

.4 Thermowells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.

.2 Thermowell to restrict flow by less than 30%.

.3 Use thermal conducting paste inside wells.

3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.5 I/P TRANSDUCERS

.1 Install air pressure gauge on outlet.

3.6 IDENTIFICATION

.1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.7 AIR FLOW MEASURING STATIONS

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.8 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Shop drawings shall include:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.

.1 Control Description Logic (CDL) for each system.

.2 Input/Output Point Summary Tables for each system.

.3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.2 REFERENCES

.1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.

.1 MD13800-[September 2000], Energy Management and Control Systems (EMCS) Design Manual. English:
Note: verify latest edition with the Owner.

1.3 SEQUENCING

.1 Present sequencing of operations for systems, except those replaced will remain unchanged.

.1 Enable all heating valve feedback signals to be available for the pump and boiler control strategy. In the absence of the feedback signal, the control signal can be used as position feedback information.

.2 Coordinate and interface with packaged boiler controllers, and new instrumentation and controls (such as variable frequency drives, etc.).

1.4 HOT WATER HEATING SYSTEM CONTROL:

.1 General:

.1 Three gas fired boilers, each equipped with a circulation pump piped in parallel to a common primary system is designed for a 22.2°C water temperature drop. Two primary pumps circulate hot water in the primary system.

.2 Secondary piping systems designed for 11.1°C water temperature drop carry hot water from cross over bridges on the primary system to:

.1 Air handler preheat and heating coils.

.2 Perimeter radiation and cabinet convectors.

.3 Unit heaters, force flows and pipe chase wall fin.

.4 Chemical Containment Lab reheat coils.

.2 Major Components:

.1 Hot water boilers B-301, B-302 & B-303.
.2 Associated boiler control valves CV-1, CV-2 and CV-3.
.3 Primary hot water pumps P-301, P-302 & P-303.
.4 Secondary water pumps P-306, P-307, P-308, P-309.
.5 Air handling unit coil loops.
.6 Bypass valve CV-199.

.3 Hot Water Heating System Control

.1 Boilers are controlled in a lead-lag-lag configuration, to maintain the supply water temperature set-point. The lead boiler changes periodically ("rotated"), i.e. first of every month. Note that the loads are cascaded: First cascade step includes pumps P-306, P-307, P-308, P-309 loops; the second cascade loop includes air handling unit coil loops.

.1 The supply hot water temperature is re-set to maintain low return water temperature – maintain heating control valve requiring most heat at 95% open.

.2 Until the feedback for the heating control valves is available, the HWS set-point may be scheduled using either control signal to represent valve position, or outdoor temperature reset (95°C when outdoor temperature is –10°C, to 60°C when outdoor temperature is 12°C). The supply water temperature may be re-set to maintain low return water temperature.

.2 The three heating boilers are each equipped with an individual (two position) water flow control valve. A flow sensor in the common flow line leaving the boilers will sequence each heating boiler and its water circulation (control valve) as demand dictates. Internal boiler flow switches are interlocked with the burners.
Note: lead boiler shall be continuously open to flow; inactive lag boilers (not required to meet the load) shall be closed to flow, to eliminate dilution of the supply water temperature.

.3 The temperature is monitored after first stage of cascading, and if it is not meeting the load for the coils, the supply water temperature is re-set.

1.5 PRIMARY LOOP FLOW CONTROL

.1 Major Components:

.1 Boiler control valves CV-1, CV-2 and CV-3.
.2 Primary hot water pumps P-301, P-302 & P-303.
.3 Bypass valve CV-199.
.4 Pressure and differential pressure sensors.

.2 The primary pumps are in a lead-lag-lag configuration, to maintain the differential loop pressure.

.3 The primary loop flow controls the boilers opened to flow (Boiler control valves CV-1, CV-2 and CV-3).

.1 Minimum primary loop flow is 5.3 L/s [85 USGPM] – set-point is adjustable. Lead boiler is always open to flow. When the lead pump is at minimum flow, the control valve CV-199 modulates to maintain the loop differential pressure set-point.

.2 The system uses one boiler for as long as the flow is below 14 L/s [222 USGPM], and above, the lag boiler is cycled.

.3 The system is not expected to exceed 28 L/s [444 USGPM], requiring a third boiler to be engaged; it may be engaged if the two boilers are not managing to maintain the temperature set-point.

.4 On a failure of a boiler, or the control valve, the next boiler is engaged.

1.6 SECONDARY LOOPS CONTROL

.1 Pump P-308

.1 The pump serves the Unit heater and force-flow loop.

.2 The pump runs continuously to maintain the loop pressure set-point.

.3 Unit heater and force flow heater fans are cycled by line voltage thermostats (existing controls to remain).

.2 Pumps P-306 and P307

.1 The pumps serve the Radiation Loop.

.2 The pumps are in a lead-lag configuration, to maintain the differential loop pressure.

.3 The pump runs continuously to maintain the loop pressure set-point.

.4 The control valve Cv-306 modulates to maintain the radiation loop set-point.

.1 The supply hot water temperature is re-set to maintain low return water temperature – maintain heating control valve requiring most heat at 95% open.

.2 Until the feedback for the heating control valves is available, the HWS set-point may be scheduled (85^{o}C when outdoor temperature is –10^{o}C, to 60^{o}C when outdoor temperature is 12^{o}C) – set-points adjustable. The supply water temperature may be re-set to maintain low return water temperature.

.5 Ground Floor perimeter radiation is controlled by two Day/Night thermostats each controlling a 2-Way valve (one on Radiation Riser SR-1 and the other on SR-3). Second Floor perimeter radiation is controlled by Day/Night thermostats (sequenced with mixing box assemblies) operating 2-Way valves on each radiant panel circuit. The radiation panels in the labs are controlled by individual mixing boxes. Existing control sequences at terminals to remain, and can be enhanced with outdoor air temperature reset.

.6 The existing 2 –Way control valve between main supply and return pipes to the radiation system will open to bypass to maintain loop differential pressure when the radiation pump is on minimum flow.

.3 Pump P-309

.1 The pump serves the Chemical Containment Reheat Coils.

.2 The pump runs continuously to maintain the loop pressure set-point.

.3 Existing control for the reheat coils on single duct variable and constant volume assemblies shall remain; they are controlled by 2-Way valves through Day/Night room thermostats and are sequenced with radiant panel control valves.

.4 Terminal boxes VV-26 and VV-28 have 3-Way valves to bypass water should excessive pressure be sensed across the radiation pumps (when at minimum flow).

.4 All preheat, radiant panel and other pumps will shut down automatically when the outside temperature exceeds 18°C; the reheat pump 309 remains operational as required. Each pump is capable of having its own independent Start/Stop temperature, which is fully adjustable.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS & SUMMARY

.1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of other Divisions.

.2 Reference to “Electrical Divisions” shall mean all sections of Division 26 in the Master Format or the Canadian Master Specifications. Reference to “Mechanical Divisions” shall mean reference to Division 23 Section 23 05 00 and Division 25, Section 25 05 01.

.3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.

.4 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.

.5 The most stringent requirements of this and other electrical sections shall govern.

.6 All work shall be in accordance with the PROJECT Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.

.7 Provide seismic restraints for all required equipment and wiring systems.

.8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Departmental Representative. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories

.9 "Consultant" shall mean Stantec Consulting Ltd.

1.2 REFERENCES

.1 Install in accordance with CSA C22.1 (current adopted edition) - except where specified otherwise.

.2 Refer to CSA C22.1 Appendix A “Safety Standards for Electrical Equipment” for applicable codes and the related revisions.

.3 Refer to CSA C22.1 Pages xxix - xxxii for related ‘Reference Publications.’

.4 Refer to NBCC Table 1.3.1.2 for applicable codes and the related revisions.

.5 Comply with Local Electrical Bulletins and by-laws relating to the Authority having Jurisdiction.

.6 Install overhead and underground systems in accordance with CSA C22.3 No.1 (current adopted edition) - except where specified otherwise.

.7 Preferred Voltage Levels for AC Systems, 0-50,000V in accordance with CAN3-C235 (current adopted edition).

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235- current edition.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SUBMITTALS

.1 Shop Drawings:

.2 Submit shop drawings, product data and samples which shall be reviewed, signed and processed.

.3 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.4 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.

.5 Content

.1 Shop drawings submitted title sheet.

.2 Data shall be specific and technical.

.3 Identify each piece of equipment.

.4 Information shall include all scheduled data.

.5 Advertising literature will be rejected.

.6 The project and equipment designations shall be identified on each document.

.7 Information shall be given in S.I. units.

.8 The shop drawings/product data shall include:

.1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights and mounting point loads.

.2 Mounting arrangements.

.3 Detailed drawings of bases, supports and anchor bolts.

.4 Control explanation and internal wiring diagrams for packaged equipment.

.5 A written description of control sequences relating to the schematic diagrams.

.6 Format

.1 Black line prints 216 mm x 280 mm or 280 mm x 430 mm.

.2 Larger drawings may be submitted on reproducible single sheet media (i.e. not bound) with space for stamps and signatures - master set plus one working copy.

.3 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.

.7 No. of copies

.1 Provide a minimum of three (3) copies or in electronic format. One (1) copy will be retained by the Consultant.

.8 Coordination

.1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Consultants.

.9 Keep one (1) copy of shop drawings and product data, on site, available for reference.

.10 Quality Control:

.1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.

.2 Submit test results of installed electrical systems and instrumentation.

.3 Submit, upon completion of work, the electrical “load balance” report.

.11 Permits and Fees:

.1 Submit to Electrical Inspection Department, local fire authorities and/or supply authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.

.2 Arrange for inspection of all work by the authorities having jurisdiction. On completion of the work, furnish final unconditional certificates of approval by the inspecting authorities.

1.6 QUALITY ASSURANCE

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial and/or Territorial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.2 Site Meetings: as part of Manufacturer's Field Services schedule site visits, to review work, at stages listed below:

.1 At time of initial shop drawing submission to confirm any existing conditions and to coordinate with the project schedule and any cross discipline requirements.

.2 After delivery and storage of products, and when preparatory work is complete but before installation begins.

.3 During progress of work at key schedule points as determined.

.4 At commissioning.

.5 Upon completion of work, after cleaning is carried out.

.3 Health and Safety Requirements: do construction occupational health and safety in accordance with safety regulations.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Consultant with schedule within 4 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and/or recycling.

1.8 SYSTEM START-UP

.1 Instruct Consultant and operating personnel in the operation, care and maintenance of equipment.

.2 Arrange and pay for services of manufacturer's factory service Engineer to supervise start-up of installation, check, adjust, balance and calibrate components, where required in these specifications.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.10 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.11 DRAWINGS AND MEASUREMENTS

.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the mechanical drawings.

.2 Consult the mechanical drawings and details for exact locations of equipment. Obtain this information from the Consultant where definite locations are not indicated.

.3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.

.4 Where imperial units have been indicated in brackets [ ] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

1.12 PROJECT COORDINATION

.1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Departmental Representative, without the Consultant's written approval.

.2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

.3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce

interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Mechanical Engineer and Consultant and all affected parties.

.4 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Consultant of space problems before installing any material or equipment. Demonstrate to the Consultant on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.13 PROVISION FOR FUTURE EQUIPMENT AND CONSTRUCTION

.1 Leave clear spaces designated for future equipment or building expansion where indicated. Plan for the installation under this contract and ensure clear accessible, unhindered access to the space is allowed for.

.2 Where contract documents don't clearly indicate the future expansion requirements, but known services are required, provide written "request for information" to the consultant before making assumptions as to intent.

1.14 SPRINKLER PROOF REQUIREMENTS

.1 All equipment and wiring systems shall be sprinklerproof standard where sprinkler fire protection systems are installed.

.2 In rooms where electrical equipment is installed surface mounted, electrical equipment contained in these rooms to be protected by non-combustible driphoods, shields, and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize watertight connectors. Top entry to be avoided where possible

.3 In particular all unit substations, transformers, switchgear, motor control and panelboard shop drawings shall be certified 'sprinkler proof' design.

1.15 EQUIPMENT RESTRAINT

.1 Related Section: 26 05 05 Seismic Restraints.

.2 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

1.16 REUSED EQUIPMENT

.1 Where existing equipment is being relocated and re-used, check and report on the condition to the Consultant before reinstallation. Protect and carefully store equipment designated for reuse.

1.17 PHASED CONSTRUCTION

.1 See Mechanical specifications and drawings for construction phasing. Make all allowances to phase the work in accordance with the project phasing.

.2 All existing services and the existing building(s) must be maintained in operation. Provide and install temporary services as required.

1.18 SEQUENCE OF WORK

.1 Before interrupting major services notify the Departmental Representative well in advance and arrange an acceptable schedule for the interruptions.

.2 Before interrupting any services complete all preparatory work as far as reasonably possible and have all necessary materials on site and prefabricated (where practical) and work continuously to keep the length of interruption to a minimum.

.3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when modifying the existing systems.

1.19 BUILDING OPERATION DURING CONSTRUCTION

.1 In order to minimize operational difficulties for the existing building staff, the various trades must cooperate with the Departmental Representative throughout the entire construction period and particularly ensure that noise is minimized.

.2 Convenient access for the staff and public to the building must be maintained at all times. Minor inconvenience and interruption of services will be tolerated, provided advance notice is given, but the Contractor will be expected to coordinate his work, in consultation with the Departmental Representative, so the operation of the facility can be maintained as nearly normal as possible.

1.20 EXISTING SERVICES

.1 Protect all existing services encountered. Every effort has been made to show the known existing services. However, the removal of concealing surfaces may reveal other existing services. Work with the Departmental Representative's staff to trace the originating source and points served. Obtain instructions from the Consultant when existing services require relocation or modifications, other than those already indicated in the Contract Documents.

.2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative's approval of the timing, and work to minimize any interruptions.

.3 Shutdowns, to permit connections, to be coordinated with the maintenance staff.

.4 In order to maintain existing services in operation, temporary relocations and wiring may be required.

.5 Be responsible for any damages to existing systems by this work.

.6 The interruption of utility services to permit tie-ins shall be arranged through the Departmental Representative’s representative. Application must be received in writing at least seven (7) calendar days prior to the date required for the shutdown. Service shutdowns shall only be carried out by Physical Plant and will normally be scheduled to occur during evenings or weekends. The Departmental Representative reserves the right to withhold permission for a reasonable period with respect to any shutdown, if the shutting-off of a service interferes with essential building operations.

1.21 SALVAGE

.1 All conduit, wiring and equipment which becomes redundant and is no longer required due to the work in this Contract shall be completely removed.

.2 All existing items which need to be removed, and which have a reasonable salvage value, shall be carefully removed and handed over to the Departmental Representative. Handing over to the Departmental Representative includes moving to Departmental Representative's designated storage place on site. These items shall not become the property of the Contractor. Obtain a written receipt from the Departmental Representative detailing each of the items handed over.

.3 Remove from the site all redundant material not required by the Departmental Representative.

1.22 WARRANTY

.1 Use of installed equipment during construction shall not shorten or alter the warranty period.

.2 Take note of any extended warranties specified.

.3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance.

.4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

1.23 EXAMINATION

.1 Visit the site before preparing the tender and examine all existing conditions. No extra cost will be considered for any misunderstanding of work to be done resulting from failure to visit the site.

.2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, or in the drawing. Obtain written clarification from the Consultant if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the more costly alternative.

1.24 RESPONSIBILITIES

.1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.

.2 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Consultant during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.

.3 Protect equipment and material from the weather, moisture, dust and physical damage.

.4 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Departmental Representative.

.5 Protect all existing services encountered. Obtain instructions from the Engineer when existing services require relocation or modification.

.6 Refinish damaged or marred factory finish to factory finish.

.7 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Consultant.

1.25 STANDARD OF ACCEPTANCE

.1 Standard of Acceptance means that the item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.

.2 Where two or more manufacturers are listed, the manufacturer's name shown first or underlined or shown with a model name and/or number was used in preparing the base design. Tenders may be based on any one of those named, provided that they meet every aspect of the base design and every aspect of the drawings and specifications.

.3 Where other than the first named or the underlined manufacturer or scheduled/specified manufacturer is selected or approved, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Equipment/materials shall not exceed the available space limitations. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.

.4 A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

1.26 ADDITION OF ACCEPTABLE MANUFACTURERS

.1 Material/products considered to satisfy the specification, but of a manufacturer other than those named may be submitted to the Consultant for consideration not later than five (5) working days prior to closing of tender or of bid depository subtrade tender whichever is earlier.

.2 Alternate approvals will be given by written addendum only. No other substitution will be permitted after closing of tenders.

.3 Alternate approvals granted before the closing of tenders will be limited to a manufacturer's system and/or series only. This limited approval will not preclude substitute equipment/material from complying with specific features included with equipment/material specified. Determine that the alternate product meets the specification intent before basing a tender on the product

.4 Where alternate equipment/materials are selected, allow for effects on other parts of the work of this Trade and other Trades. Where substantial changes in arrangement are required, submit shop drawings of the proposed changes with Plan and Section views and show effects on work of other Trades. Alternate equipment/materials shall not exceed the available space limitations. Maintain installation, access and servicing clearances. No extra will be allowed due to the use of alternate equipment/materials.

.5 Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.

.6 Install and test all equipment and material, in accordance with the detailed recommendations of the manufacturer.

1.27 PROJECT CLOSE-OUT REQUIREMENTS

.1 Refer to detailed specifications in each section for detailed requirements. Record drawings to be submitted to Consultant and all life safety systems must be operational, verified and tested and demonstrated to Consultant prior to issuance of Schedule C.

1.28 SUBSTANTIAL PERFORMANCE REQUIREMENTS

.1 Before the Consultant is requested to make an inspection for substantial performance of the work:

.1 Commission all systems and prove out all components, interlocks and safety devices.

.2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed.

.3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Consultant, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.

.2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:

.1 All reported deficiencies have been corrected.

.2 Operating and Maintenance Manuals completed.

.3 "As Built" Record Drawing ready for review.

.4 Systems Commissioning has been completed and has been verified by Consultant.

.5 All demonstrations to the Departmental Representative have been completed.

.3 Consultants Letters of Assurance will not be issued until the following requirements have been met:

.1 All items listed in above have been completed or addressed.

.2 Certificate of Penetrations through separations.

.3 Provincial or City Electrical Inspection - Certificate of inspection.

.4 Seismic Engineers letter of Assurance and final inspection report.

.5 Certificate of Substantial Performance.

.6 Signed off copy of Consultants final inspection report.

1.29 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

.1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.

.2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 26 work have been met and verified.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01 - Sustainable Requirements: Construction

.2 Do verification requirements in accordance with Division 01 - Sustainable Requirements: Contractor's Verification.

2.2 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment as follows.

.2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.

.3 Where equipment or materials are specified by technical description only, they are to be of the best commercial quality available for the intended purpose.

.4 Factory assembled control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Provide all power and control wiring, conduit, wire, fittings, disconnect switches, motor starters, for all mechanical equipment unless otherwise specified.

.2 Ground all motors to conduit system with separate grounding conductor in flexible conduit or bonding conductor in the flexible conduit.

.3 Connections shall be made with watertight flexible conduit with watertight connectors.

.4 Control wiring and conduit standards are specified in the Electrical Divisions. Refer to Mechanical Divisions for scope of work and particular details.

2.4 WARNING SIGNS

.1 Provide warning signs, as specified or to meet the requirements of Inspection Department, Authority Having Jurisdiction and Engineer.

.2 Use decal signs, minimum 175 x 250 mm [7” x 10”] size

2.5 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify all electrical equipment including but not limited to starters, disconnects and controls with nameplates and labels as follows:

.2 Nameplates:

.1 Lamicoid 3 mm [0.125”] thick plastic engraving sheet, white face, black core, self-adhesive unless specified otherwise. Provide white face, red core for all essential distribution equipment.

.2 Nameplate Sizes:

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.3 Typical Labelling:

.1 Panelboard & CDP – 5 lines

.1 Line 1 – e.g. Conditional/Vital – Size 4 lettering

.2 Line 2 – Panel/CDP designation – Size 4 lettering

.3 Line 3 – e.g. 225A, 120/208V, 3 phase 4W – Size 2 lettering

.4 Line 4 – Feeder: e.g. 4#3 – 35mm C – Size 2 lettering

.5 Line 5 – Origin e.g.: Main Elect. Room – Size 2 lettering

.2 Distribution Circuit Breakers – 4 lines

.1 Line 1 – Conditional/Vital – Size 4 lettering

.2 Line 2 – Main Circuit Breaker – Size 4 lettering

.3 Line 3 – Feeder: e.g. 4#3 – Size 2 lettering

.4 Line 4 – Origin: e.g. K1 Sub-station – Size 2 lettering

.3 Label colours unless otherwise indicated:

.1 120/208V labels: white letters on black base.

.2 347/600V labels: Black letters on white base.

.3 Standby/Emergency Power: white letters on red base.

.4 Wording on nameplates to be approved prior to manufacture.

.5 Allow for average of twenty-five (25) letters per nameplate.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages.

.3 Labels:

.1 Identify each outlet, starter, disconnect and all items of fixed equipment with the appropriate panel and circuit number origin by means of a small but good quality vinyl, self-laminating label such as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected. Confirm location of labels with Consultant before installing. Circuit number to agree with Record Drawings.

.4 Provide plastic covered panel directory with circuits and areas served typed in, and mounted on inside of door. Directory to conform to Record Drawings.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

.1 Colour code conduits, metallic sheathed cables, pullboxes and junction boxes.

.2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.

.3 Colour coding to be as follows unless otherwise specified:

SYSTEM	MAJOR BAND	MINOR BAND	CHARACTERS
347/600V Normal	Dark Blue		
347/600V Conditional	Dark Blue		
347/600V Emergency	Dark Blue	Red	
120/208V Normal	Light Blue		
120/208V Conditional	Light Blue		
120/208V Emergency	Light Blue	Red	
Ground	Dark Green		GR
BAS (Digital)	White	Green	BCD
BAS (110V)	White	Black	BCH
BAS (LV)	White	Blue	BCL
PLC (Digital)	White	Brown	PLC
Low Voltage Control	White	Yellow	LVC

.4 Obtain the Departmental Representative’s sign off for the colour coding prior to the identification process.

2.9 FINISHES

.1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two (2)coats of finish enamel.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.

.3 Clean and prime paint exposed hangers, racks, fastenings to prevent rusting.

2.10 ACCESS PANELS (DOORS)

.1 Unless otherwise noted, access doors shall be minimum: 450mmx450mm [18"x18"] for body entry; 300mmx300mm [12”x 12”] for hand entry.

.2 Access doors in fire separations of 3/4 hour rating, and higher, and firewalls shall have a compatible fire rating and a ULC label with tamper-proof latch, self-closing.

.3 Minimum Requirements:

.1 180 degree door swing, mitred rounded safety corners flush welded, concealed hinges, screwdriver latches, and anchor straps or lugs to suit construction, all steel prime coated.

.2 Plaster or wet wall construction: 14 gauge bonderized steel flush with wall or ceiling type with concealed flange.

.1 Acceptable Product: Acudor PS-5030.

.3 Masonry or drywall construction: 16 gauge for 400 mm [16"] x 400 mm [16"] and smaller, 14 gauge for 450 mm [18"] x 450 mm [18"] and larger bonderized steel face of wall type with exposed flange.

.1 Acceptable Product: Acudor UF-5000.

.4 Tile, ceramic tile, marble, terrazzo, plaster or wet wall construction in washrooms and other special areas: 14 gauge stainless steel flush with wall or ceiling type with concealed flange.

.1 Acceptable Product: Acudor PS-5030 stainless.

.5 Access panels in fire separations and fire walls shall have a compatible fire rating and ULC label. (i.e. Acudor Fire Rated FW-5050 or FB-5060).

.4 Standard of Acceptance: Zurn, Wade, Acudor, Can-Aqua, Milcor, Maxam, Van-Met.

2.11 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation by other Divisions.

2.12 FASTENING TO BUILDING STRUCTURE

.1 General:

.1 Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. The comprehensive design of all supports and anchorage related to the proposed electrical alternations and additions shall be signed and sealed by a specialty professional engineer licensed in the Province of British Columbia. Submit a signed and sealed copy of such design calculations and drawings for the Engineer’s review upon request. Submit such specialty scope

related Schedules and Letter of Assurance Compliance upon request. Perform fastening according to the following unless other fastening methods are indicated:

a. Wood: Fasten with wood screws or screw-type nails.
b. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
c. New Concrete: As indicated in structural drawing S0.01.
d. Existing Concrete: As indicated in structural drawing S0.01.
e. Steel: Welded threaded studs or spring-tension clamps on steel. All roof supported elements shall be supported off the top cord of OWSJ or top flange of steel beam members. Existing steel surface will be prepared as necessary for welding. Post-welding, the connection to existing steel will be ground smooth and cleaned to remove scales, over-burnt weld material and painted (with primer or zinc-rich material such as galvacon, etc.) to match existing.
f. Field Welding: Comply with AWS D1.1. or CSA Standard W50-03.
g. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
h. Light Gage Steel: Sheet metal screws. Do not fasten screw to existing steel deck. All roof supported elements shall be supported off the top cord of OWSJ or top flange of steel beam members.
i. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

.2 Note:

.1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.

.2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.

.3 Where specifically called for, drills shall include a dust vacuum system, Hilti SAV Dust Vacuum System.

2.13 EQUIPMENT SUPPORTS

.1 Provide stands and supports for equipment and materials supplied.

.2 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.

.3 Support ceiling hung equipment with rod hangers and/or structural steel.

2.14 MISCELLANEOUS METAL

.1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:

.1 Support of equipment.

.2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.

.3 Earthquake restraint devices - refer also to “Seismic Restraint” sections.

.2 All steel work shall be prime and undercoat painted ready for finish under the related Division.

2.15 MAINTENANCE MATERIALS AND CABINET

.1 Provide maintenance materials in accordance specified in appropriate Sections.

2.16 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into maintenance manual specified as follows.

.2 Include in operations and maintenance data:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.

.3 Wiring and schematic diagrams.

.4 Names and addresses of local suppliers for items included in maintenance manuals.

.3 Include in the manual the following major sections:

.1 Title page (in plastic cover).

.2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.

.3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and troubleshooting instructions.

.4 Local source of supply for each item of equipment.

.5 Wiring and control diagrams.

.6 Spare parts list.

.7 Copies of guarantees and certificates.

.8 Manufacturer's maintenance brochures and shop drawings.

.4 The manual information shall be bound in a three “D-ring” hard back reinforced vinyl covered ("bar lock" post type where more than 50mm [2”] rings required) binder c/w index tab separators to divide the different sections. The binder cover shall be black with white lettering. Printing of the binder cover shall be completed before the binder is manufactured and the wording shall be approved by the Consultant before printing.

.5 Submit a draft copy to the Consultant for review thirty (30) days prior to start-up of the systems and equipment.

.6 Submit three (3) copies in the final approved form.

2.17 PROJECT RECORD DRAWINGS

.1 Provide project record documents as called for in this Division.

.2 During the construction period, keep on Site a clean set of drawings marked up to reflect the "As-Built" state, for examination by the Consultant on a regular basis. Include elevations and detailed locations of buried services, empty conduit systems and junction and pull boxes.

.3 At the time of "substantial performance" purchase a set of CAD files from the Consultant. The Electrical Division shall include all associated costs to obtain and complete the CAD Record Drawings including retaining the services of an approved CAD draftsperson to transfer all changes to amend the CAD files in the latest version of AutoCAD. Include all revisions and change orders.

.4 Submit the "Record Drawing" CAD files and one set of plots to the consultant prior to Total Performance of the contract.

.5 Note: The Contractor will be required to sign a standard Stantec / Contractor agreement entitled "Authorization to Use CAD drawing files". The agreement restricts the use of the CAD files to the purpose of "as-built" only and determines the editing procedures.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No. 1 except where specified otherwise.

.3 Comply with CSA electrical bulletins and local by-laws.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit and protruding 50 mm [2”].

.2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.3 Install roof jacks where conduit and cables penetrate roofs. Apply sealant after installation.

.4 All cables and conduits to be installed concealed in finished areas.

3.4 LOCATION OF OUTLETS

.1 Do not install outlets back-to-back or in the same stud space in wall; allow minimum 400mm [16”] horizontal clearance between boxes.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm [10”- 0”] and information is given before installation.

.3 Locate disconnect devices in mechanical rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not indicated verify before proceeding with installation. Confirm the height of devices in handicapped facilities before installation.

.3 Refer to detail on drawings.

3.6 COORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to the required values and settings to provide a fully coordinated system.

3.7 FIELD QUALITY CONTROL

.1 Load and Balance:

.1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase and neutral currents to dry-core transformers and motor control centres, operating under normal load.

.3 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.2 Conduct and pay for the following tests:

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.4 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Provide Consultant with at least one week’s notice prior to testing.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.

.2 Furnish manufacturer's certificate or letter conforming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.3 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.4 Schedule site visits to review Work.

.6 Reports:

.1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.8 CLEANING

.1 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting.

3.9 WORKMANSHIP

.1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.

.2 The Consultant shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.

.3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Consultant.

3.10 PROTECTION OF WORK

.1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.

.2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.

.3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.

.4 Refinish damaged or marred factory finish.

3.11 PROTECTION OF ELECTRICAL EQUIPMENT

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts, e.g. "LIVE 120 VOLTS."

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.12 CONCEALMENT

.1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.

.2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.13 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

.1 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system, in accordance with CAN4-S115-95, that meets the requirements of the Building code in effect.

.2 The scope includes new services which pass through existing rated separations and also all existing services which pass through a new rated separation or existing separations whose rating has been upgraded.

.3 Fire resistance rating of installed firestopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings. Where this is not indicated assume a minimum of one hour for walls and two hours for floors.

.4 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system as detailed above.

.5 Contractors are expected to submit system information detailing firestopping product, backing, penetrant, penetrated assembly, Fire (F) and Temperature (T) rating, and ULC or cUL system number.

.6 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be repenetrated.

.7 All penetrations are to be firestopped using EZ Path System (Specified Technologies Inc. - STI) only.

.8 Allow openings for 100% capacity of raceway or 200% capacity of J-hooks.

.9 Provide split systems where existing cables are involved.

.10 Provide Firestopping approval certificate in including a Building Code / By-Law Schedule B and C-B signed by a BC registered Professional Consultant. Submit a letter certifying that all work is complete and in accordance with this specification.

3.14 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

.1 All cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.15 CONDUIT SLEEVES

.1 Provide conduit sleeves for all conduit and wiring passing through rated walls and floors. Sleeves to be concentric with conduit or wiring.

.2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.

.3 Conduit sleeves shall extend 50 mm [2"] above floors in unfinished areas and wet areas and 6 mm [1/4"] above floors in finished areas.

.4 Conduit sleeves shall extend 25 mm [1"] on each side of walls in unfinished areas and 6 mm [1/4"] in finished areas.

.5 Conduit sleeves shall extend 25mm [1"] beyond exterior face of building. Caulk with flexible caulking compound.

.6 Sleeve Size: 12 mm [1/2"] clearance all around, between sleeve and conduit or wiring.

.7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.

.8 Packing of Sleeves:

.1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.

.2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.16 ACCESSIBILITY AND ACCESS PANELS

.1 Install all equipment, controls and junction boxes so as to be readily accessible for future modification, adjustment, operation and maintenance as appropriate.

.2 Provide access panels where required in building surfaces. Do not locate access panels in panelled or special finish walls, without prior approval of the Consultant.

.3 Access panels in U.L.C. fire separations and fire walls shall have a compatible fire rating and U.L.C. label. Acquire approval in writing from the local fire authority if required.

.4 Access panels shall be painted with a primer coat if applicable and then with a finish coat, colour and type to the Consultant's approval.

.5 Locate equipment and junction boxes in service areas wherever possible.

3.17 EQUIPMENT INSTALLATION

.1 Provide means of access for servicing equipment.

.2 CSA identification and equipment labels to be clearly visible after installation.

3.18 CUTTING, PATCHING, DIGGING, CANNING , CORING & CONCRETE

.1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.

.2 Be responsible for all cutting, patching, digging, canning and coring required to accommodate the electrical services.

.3 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.

.4 X-ray and verify the location of existing and planned service runs and structural components within concrete floor and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.

.5 Openings through structural members of the building shall not be made without the approval of the Structural Consultant.

.6 Openings in Concrete:

.1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.

.2 All openings shall be core drilled or diamond saw cut.

.3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.

.4 Refer to structural drawings for locations of steel reinforcing.

.5 Be responsible for repairing any damage to steel reinforcing.

.7 Openings in building surfaces other than concrete:

.1 Lay out all openings required.

3.19 PAINTING

.1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.

.2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.

.3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish. Repainting of factory finished must be undertaken in accordance with manufacturer’s instruction and approved processes in order to preserve warranties and appropriate ratings.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification is to be read, coordinated and implemented in conjunction with all other parts of the Contract Documents.

1.2 REGULATORY REQUIREMENTS

.1 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.

.2 The Seismic Consulting Engineer should be able to provide a proof of professional insurance and the related practice credentials if requested by the Electrical Consultant. The Seismic Consulting Engineer should be familiar with SMACNA, ECABC & NFPA guidelines as well as BCBC and VBBL requirements.

.3 The Contractors Seismic Consultant shall submit original signed BC Building Code "Letters of Assurance" "Schedules B and C-B" to the Prime Consultant or Electrical Consultant.

.4 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.3 SCOPE

.1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

.2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components.

.3 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.

.4 The total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This engineer, herein referred to as the Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.

.5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.

.6 The Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.

.7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.

.8 The Seismic Consultant shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.

.9 Include all costs associated with the Seismic installation and certification in the base tender.

1.4 SHOP DRAWINGS & SUBMITTALS

.1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic consultant.

.2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Consultant.

Part 2 Products

2.1 SLACK CABLE SYSTEMS

.1 Slack cable restraint systems shall be as designed and supplied by Vibra-Sonic Control or equal.

.2 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the engineer and inspection authority having jurisdiction.

.3 Coordinate requirements of slack cables with suppliers prior to installation.

Part 3 Execution

3.1 GENERAL

.1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

3.2 CONDUITS

.1 Provide restraint installation information and details on conduit and equipment as indicated below:

.2 Vertical Conduit:

.1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.

.3 Horizontal Conduits:

.1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.

.2 EMT tubing - tubing shall be supported at approximately 1.2 m intervals for tubing.

.4 Provide transverse bracing at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90º bend assemblies, and pull box locations.

.5 Provide longitudinal bracing at 24.4 m o.c. maximum unless otherwise noted.

.6 Do not brace conduit runs against each other. Use separate support and restraint system.

.7 Support all conduits in accordance with the capability of the conduit to resist seismic load requirements indicated.

.8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.

.9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

.10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.

.11 It is the responsibility of the contractor to ascertain that an appropriate seismic restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic consultant and submit shop drawings to consultants for their reference.

3.3 FLOOR MOUNTED EQUIPMENT

.1 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 SCOPE

.1 The Electrical Division to take note that the demolition and renovation will be done in an occupied building that is normally occupied during the day. Maintain electrical and communication systems as required to minimize services disruption.

.2 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Consultant who will provide instruction.

Part 2 Products

2.1 STANDARDS

.1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

Part 3 Execution

3.1 DEMOLITION

.1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities.

.2 All redundant electrical components in the areas of demolition excluding those specifically identified in the following clauses shall become the property of the Electrical Division and shall be removed from site.

3.2 DISRUPTION TO OPERATIONS

.1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before start-up.

.2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

3.3 REUSE OF EXISTING COMPONENTS

.1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location.

3.4 DISTRIBUTION OF CIRCUITS

.1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, to be made good immediately. The Electrical Trade(s) to identify these circuits to the Consultant. Specific tasks involving the demolition of essential circuits will require that the contractor to obtain permission from the Owner before proceeding.

3.5 ABANDONED CONDUIT, WIRE AND EXISTING CIRCUITS

.1 All abandoned conduit and wire to be removed and disposed of by the Electrical Divisions.

.2 Remove all accessible (e.g. surface) wiring and cables back to source.

.3 All remaining circuits to be rerouted as required and suitably secured to the building structure.

3.6 EXCAVATION AND CUTTING DAMAGE

.1 Circuits disrupted by floor cutting or drilling (i.e. buried cables) to be brought to the attention of the consultant. Obvious systems disturbed because due care and attention was not followed, shall be repaired immediately at no additional cost to owner.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 TERMS OF REFERENCE

.1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated. Refer to "Site Services" Section for allowable site conduits as an alternative to steel.

.2 Aluminium conductors only permitted where indicated on drawings and then typically only for feeder conductors larger than 3/0 AWG. All conductor sizes indicated on drawings are based on copper conductors unless otherwise noted.

.3 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-4 flame spread rating.

.4 Cabling indicated to be 2-Hour Fire-Rated shall be Mineral Insulated or compliant to CAN/ULC-S139 and CSA 38-95 (Draka Lifeline, Raychem RHW, or Shawflex). Cabling shall be low smoke halogen free. Conduit to be sized and installed as per manufacturer's requirements for these specialized cables and assemblies regardless of the size indicated on drawings.

.5 Provide all control wiring except HVAC controls as specified in Mechanical Divisions.

.6 Refer to Equipment Schedule(s) for detailed responsibilities.

.7 Non-metallic sheathed wiring is not to be used on this project.

Part 2 Products

2.1 WIRING & CABLES – GENERAL

.1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.

.2 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.

.3 Use RWU90XLPE for underground installations.

.4 TBS90 #14 AWG stranded shall be used in all switchgear assemblies. Current transformer secondary wiring shall be #12 AWG stranded. Current transformer leads shall incorporate ring type tongues for termination purposes.

.5 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a

minimum of 50 mm at terminations, junctions and pullboxes and condulet fittings. Conductors not to be painted.

2.2 TECK 90 CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors: copper and sized as indicated.

.3 Insulation: Chemically cross-linked thermosetting polyethylene rated type RW90XLPE, 600V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: flat galvanized steel.

.6 Overall covering: PVC jacket with FT-4 flame spread rating. PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.

.7 Fastenings:

.1 One (1) hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors: Watertight approved for TECK cable.

2.3 LOW VOLTAGE CONTROL CABLES

.1 Type LVT: soft annealed copper conductors, with thermoplastic insulation, outer covering of thermoplastic jacket. Minimum size #18 AWG.

.2 Unless otherwise specified wiring to be multicore individually identified and colour coded with grey sheath enclosed in conduit or (EMT).

2.4 WIRE & BOX CONNECTORS

.1 Pressure type wire connector current carrying parts to be copper and sized to fit conductors used.

.2 Fixture type splicing connector current carrying parts to be copper sized to fit conductors 10 AWG or less.

.3 Bushing stud connectors to EEMAC 1Y-2 and suitable for stranded copper conductors.

.4 Clamps or connectors for armoured cable, flexible conduit, as required.

Part 3 Execution

3.1 INSTALLATION

.1 Install all cables and wiring.

.2 Conductor length for parallel feeders to be identical. Provide permanent plastic nametag indicating load fed.

.3 Group Teck cables on channels wherever possible.

.4 Lace or clip groups of feeder conductors at all distribution centres, pullboxes, and termination points.

.5 Wiring in walls should typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls should be avoided unless indicated.

.6 All grounding conductors and straps to be copper. All bonding conductors to have green insulation jacket.

.7 Colour coding to be strictly in accordance with Section 26 05 00.

.8 Provide sleeves where cables enter or exit cast concrete or masonry.

.9 Power wiring up to and including No.6 gauge shall be spliced with nylon-insulated expandable spring-type connectors. Large conductors shall be spliced using split-bolt or other compression type connectors wrapped with cambric tape then PVC tape.

.10 Wires shall be sized for 2% maximum voltage drop to farthest outlet on a loaded circuit. Increase home run cable size to meet these requirements.

.11 Install all control cables in conduit.

.12 Provide numbered wire collars for all control wiring. Numbers to correspond to control drawing legend. Obtain wiring diagram for control wiring of other Divisions.

3.2 VOLTAGE REGULATION

.1 The drawings are diagrammatic and indicate the general routing of conduit runs and not exact routing, either horizontally or vertically.

.2 Branch circuit conductor sizes shall be #12 AWG or larger based on the Canadian Electrical Code CSA 22.1 Section 8, which allows a maximum 3% voltage drop for branch circuits.

3.3 WIRE & BOX CONNECTORS

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).

.2 Transformer grounding shall comply with CSA C22.2 No.41.

.3 All grounding conductors to be stranded soft annealed copper unless otherwise noted.

.4 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.

1.4 TESTING REQUIREMENTS

.1 Perform ground continuity and resistance tests using method appropriate to site conditions. Measure ground grid resistance.

.2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

1.5 ADDITIONAL SCOPE

.1 Refer to drawings for extent of grounding in addition to code requirements.

Part 2 Products

2.1 MATERIALS

.1 Grounding equipment to: CSA C22.2 No.41.

2.2 EQUIPMENT

.1 Clamps for grounding of conductor, size as required.

.2 System and circuit, equipment, grounding conductors, bare stranded copper, and soft annealed, sized as indicated. Insulation where specified or required to be green.

.3 Non-corroding accessories necessary for grounding system, type, size material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

2.3 STANDARDS OF ACCEPTANCE

.1 Acceptable manufacturers:

.1 Burndy Corp.

.2 Erico Inc.

.3 Cadweld.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.

.2 Provide ground wire in EMT conduits installed in grade or below slabs.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit. Provide a ground conductor in all flexible conduit and secure to system grounding lugs at both the equipment and source.

.8 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.9 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.

.10 Provide a bonding conductor appropriately sized within each raceway routed within the building.

.11 All bonding and grounding connections to be compression type unless noted otherwise.

.12 Ground the secondary winding of potential and current transformers.

.13 Supply and install complete grounding and bonding system as indicated and as required by Canadian Electrical Code and the local electrical inspection authorities.

.14 All components shall be securely and adequately bonded and where required to accomplish this, bonding jumpers, grounding studs and bushings shall be used.

.15 All metallic conduits longer than 1m in length, containing a single grounding or bonding conductor, shall be bonded as per the Canadian Electrical Code.

3.2 EQUIPMENT GROUNDING OR BONDING

.1 Install grounding or bonding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, duct systems, frames of motors, motor control centres, starters, control panels and distribution panels.

3.3 MECHANICAL EQUIPMENT GROUNDING

.1 Provide a #2 ground conductor from the mechanical room ground bus to each MCC.

.2 Provide a #6 ground conductor from the mechanical room ground bus to each VFD.

.3 Ground wires to be installed in all conduit serving motor feeder circuits and to extend to ground screws on junction and outlet boxes for bonding.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions.

.3 Measure ground grid resistance with earth test megohmmeter and install additional ground rods and conductors as required until resistance to ground complies with Code requirements and is less than 1Ω.

.4 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Consultant. Include all associated costs.

.5 Ensure test results are satisfactory before energizing the electrical system.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 00.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm [1”] minimum extension all around, for flush-mounted pull and junction boxes.

2.2 CABINETS

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle and catch, for surface mountings.

.2 Type T: sheet steel cabinet, with full length hinged door, latch, lock, 2 keys, containing 19 mm G1S fir plywood backboard for surface or flush mounting as appropriate.

.3 Include filtered vents and/or fan-cooling when enclosed equipment is heat producing.

2.3 FINISHES

.1 Apply finishes in accordance with Section 26 05 00.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible spaces.

.2 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 m of conduit run between pull boxes.

.3 Provide pull boxes and junction boxes in locations shown on the drawings and as required to suit job conditions.

.4 Locate pull boxes and junction boxes above removable ceilings, in electrical rooms, utility rooms or storage areas.

.5 Junction boxes, when used, to be installed in areas that are accessible through luminaire openings, and/or access panels.

.6 Where pull boxes are flush mounted, provide overlapping covers with flush head cover retaining screws, prime coated and painted to match wall or ceiling finish.

.7 Where cast corrosion resistant boxes are used, covers to be of matching type and gasketted.

.8 For special (not 100mm [4”] square or octagonal) pull boxes and/or junction boxes, paint identification for the system and provide lamicoid nametags to box covers with a size 2 nameplate 5mm [0.25”] lettering identifying system.

.9 Interior of all pull boxes and junction boxes for each system to be spray painted with colour as specified in Section 26 05 00.

.10 All pull boxes, junction boxes and cabinets to be supported directly from building structure using one or a combination of galvanized screws, galvanized bolts, galvanized rods, and approved box clip.

.11 Support of pull boxes, junction boxes by conduit fittings or wire is not acceptable.

3.2 CABINETS INSTALLATION

.1 Mount cabinets with top not higher than 2 m [6’] above finished floor.

.2 Cabinets shall be flush mounted in finished areas where depth can be accommodated in the walls. Provide flush trim to suit.

.3 Provide fit up in Type T cabinets as indicated.

3.3 IDENTIFICATION

.1 Install size 2 identification labels indicating system name, voltage and phase in accordance with Section 26 05 00.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES IN GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm [4”] square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm [3" x 2" x 1.5"] or as indicated. Larger 102 mm square x 54mm deep [4”x 2”] outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.

.2 For larger boxes, use GSB solid type as required.

.3 102 mm [4”] square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi-gang type MDB boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 SURFACE CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

2.6 FITTINGS – GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of foreign materials.

.3 Conduit outlet bodies for conduit up to 35 mm [1.25”]. Use pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm [0.25”] of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.

.5 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.

.6 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.

.7 No sectional or handy boxes to be installed.

.8 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.

.9 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 All conduits and accessories to be manufactured and certified by the related CSA standard.

1.3 SCOPE

.1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

.2 Conceal all conduits where possible in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.

.3 If a finished area is concrete (existing) or concealment is not practical, obtain ruling from Consultant where exposed wiremold may be substituted.

.4 Note particular requirements for routing of conduits where detailed.

.5 Provide polypropylene pull cord in all “empty” conduits.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.

.2 Epoxy coated conduit: to CSA C22.2 No.45 with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.

.4 Rigid PVC conduit: to CSA C22.2 No.211.2.

.5 Flexible metal conduit: to CSA C22.2 No.56 liquid-tight flexible metal conduit.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 41mm [1.5”] and smaller. Use two hole steel straps to conduits larger than 41mm [1.5”].

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 10mm [3/8”] threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings manufactured for use with conduits specified. Coating same as conduit.

.2 Provide factory "ells" where 90 degree bends are required for 27mm [1”] and larger conduits.

.3 EMT couplings and connectors shall be steel, or Regal Die-cast zinc alloy. Couplings used on conduit containing fire-rated cable shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors unless there is no chance of burrs. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. panelboards, MCCs, etc.) in rooms that are fire sprinkler protected.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.

.2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 21mm [3/4”] deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

2.5 RIGID P.V.C. CONDUIT

.1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride as manufactured C.G.E. "Sceptre."

.2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.

.3 Solvent: as recommended by conduit manufacturer.

Part 3 Execution

3.1 INSTALLATION - GENERAL

.1 Generally use electrical metallic tubing (EMT) in the building interior and in above grade slabs except where subject to mechanical injury or where otherwise indicated.

.2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.

.3 Where practical conceal conduits.

.4 Any exposed conduit in finished areas to be free of unnecessary labels and trademarks.

.5 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.

.6 Ensure grounding continuity in all conduit systems.

.7 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.

.8 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5m [5’] above the finished floor.

.9 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.

.10 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.

.11 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.

.12 All home-run branch circuit conduit to be minimum 21 mm [3/4”] diameter unless otherwise indicated.

.13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: e.g. where conduits emerge from ground level slab.

.14 Conduits are not permitted in terrazzo or concrete toppings.

.15 Cap turned up conduits to prevent the entrance of dirt of moisture during construction.

.16 Locate conduits more than 75mm [3”] parallel to steam or hot water lines with a minimum of 25mm [1”] at crossovers.

.17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.

.18 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.

.19 Damaged conduits to be repaired or replaced.

.20 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.

.21 Conduits shall not pass through structural members except as indicated.

.22 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.

.23 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.

.24 Seal conduits with approved sealant where conduits are run between heated and unheated areas.

.25 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.

.26 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.

.27 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels.

.28 Use "Condulet" fittings for power conduit terminations in lieu of standard boxes where box support is not provided.

.29 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.

.30 Use flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box and connection to recessed fluorescent fixtures.

.31 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.

.32 Use explosion proof flexible connection for connection to explosion proof motors.

.33 Install conduit-sealing fittings in hazardous areas, isolation rooms and clean rooms. Fill with compound.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with minimum 1.5m [5’] clearance.

.3 Conduits to be run in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended and/or surface channels.

.5 Surface conduits will not be accepted in finished areas unless detailed.

3.3 EXPANSION JOINT CONDUIT FITTINGS

.1 Provide conduit expansion joint fittings at concrete expansion joint.

3.4 RIGID P.V.C. CONDUIT

.1 Use in accordance with the Canadian Electrical Code and Building Codes and as noted below:

.2 Use as raceways for following applications

.1 In poured slab on grade concrete floors and walls and for underground runs exterior to the buildings unless otherwise noted.

.2 Wiring installed in areas subject to intermittent or continuous moisture but not surface mounted.

.3 Rigid PVC conduit shall not be surface mounted or exposed within buildings.

.3 Do not use in return air plenums or for exit light circuits and emergency lighting.

.4 Provide insulated ground wire in all rigid PVC conduits in accordance with the Canadian Electrical Code.

.5 Where rigid PVC conduit is set in poured concrete, solvent joints must be completed and allowed to set as per manufacturer's instructions before pour.

.6 Bend rigid conduit in strict accordance with manufacturer's directions. Distorted bends will not be accepted.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.2 Section 26 24 21 – HVAC and Plumbing Controls.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 26 05 00.

.2 Indicate:

.1 Mounting method and dimensions.
.2 Starter size and type.
.3 Layout of identified internal and front panel components.
.4 Enclosure types.
.5 Wiring diagram for each type of starter.
.6 Interconnection diagrams.

1.4 OPERATION AND MAINTENANCE DATA

.1 Provide data for incorporation into maintenance manual specified in Division 01 and Section 26 05 00.

.2 Include operation and maintenance data for each type and style of starter.

1.5 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 26 05 00.

.2 Provide listed spare parts for each different size and type of starter:

.1 2 contacts, stationary.
.2 2 contacts, movable.
.3 1 contact, auxiliary.
.4 1 operating coil.
.5 2 fuses.
.6 4 indicating lamps.

Part 2 Products

2.1 MATERIALS

.1 Starters: to CSA C22.2 No.14.

.2 Half size starters not acceptable.

2.2 MANUAL MOTOR STARTERS

.1 Single phase manual motor starters of size, type, rating and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One overload heater, manual reset, trip indicating handle.

.3 Flush mounted in finished areas.

.4 Pilot light.

.2 Accessories:

.1 Toggle switch labelled as indicated.

.2 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Three pole adjustable overload relay(s) with single phase protection feature.

.3 Motor overload protective device in each phase, manually reset from outside enclosure.

.4 Wiring and schematic diagram inside starter enclosure in visible location.

.5 Provide a fixed 10 point terminal strip for all controls.

.6 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.7 Control transformers to be line voltage to 120 V of sufficient VA to handle operating coil and associated auxiliary controls. Provide primary and secondary HRC fusing.

.8 Provide fused circuit and terminal blocks.

.9 Provide the following accessories:

.1 Hand-off-auto selector switches, start/stop/reset buttons or on/off control as indicated.

.2 Loads served labelled as indicated.

.3 Indicating lights: standard type and colour as indicated.

.4 2-N/O and 2-N/C spare auxiliary contacts in addition to the holding contacts unless otherwise indicated.

.5 Support facilities for load sensing ring type CT on Phase C of motor circuit.

.2 Two (2) sets of auxiliary contacts - normally Open in addition to standard auxiliary holding contacts supplied with each contactor making a total of three (3) auxiliary contacts. One (1) set of auxiliary contacts to be convertible to normally closed.

.3 CEMA 1 enclosure unless otherwise indicated.

2.4 COMBINATION STARTERS

.1 In addition to “Full Voltage Magnetic Starters” above, provide 3 pole magnetic trip moulded case breaker and operating handle with lock-off facility.

.2 Enclosure "Opening" to be restricted by use of a defeater screw unless switch is in "Off" Position.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size 5 engraved as indicated.

.4 MCC designation label, white plate, black letters, size 7 engraved as indicated.

2.6 STANDARDS OF ACCEPTANCE

.1 Cutler Hammer.

.2 Siemens.

.3 General Electric.

.4 Klockner Moeller.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters and MCC assemblies.

.2 Connect power and control as indicated.

.3 Provide interlocking between starters where required.

.4 In finished areas, provide flush mounted remote controls and manual motor protection starters complete with stainless steel coverplates and pilot lights unless otherwise indicated. Provide key operated motor protection starters where indicated or in normally accessible areas where unauthorized operation could be a functionality issue.

.5 Select overload settings to suit full load current of motors installed that may differ from the design loads. Confirm with other Divisions.

.6 Ensure correct control fuses and overload devices elements installed.

.7 Provide disconnects at all equipment.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 and manufacturer's instructions.

.2 Operate controls, switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 SCOPE OF WORK

.1 In general the HVAC and the Plumbing/Fire Protection motors and drives will be respectively provided under the Mechanical Division and Plumbing/Fire Protection Divisions. Refer to the related division of the specifications and drawings for exact locations and requirements.

.2 Provide the following components:

.1 All disconnect switches required.

.2 All starters, contactors, control transformers, except where supplied by the Mechanical or Plumbing/Fire Protection Divisions as noted in the equipment schedule.

.3 Thermostats, solenoid valves, pressure switches, aquastats, flow switches, timeclocks are generally provided by the Mechanical or Plumbing Divisions except as noted in the equipment schedule(s).

.4 Refer to equipment schedule(s) on Drawing E-0.01 for details of motor controls and devices.

.5 Provide all power wiring from power distribution centre, through starter and control equipment to the motors.

.6 Conduit, wire and connections for all HVAC low voltage control wiring shall be the responsibility of Mechanical Division unless otherwise specified.

.7 Provide, connect and verify all Fire Alarm control wiring and devices.

1.3 CONTROLS - GENERAL

.1 Mechanical and Plumbing Divisions differ both in regard to the particulars of drives, motors, etc. specified. The Mechanical Division typically includes a major section on controls whereas the Plumbing Division typically includes more package equipment requiring power service connection only. Because of these variations the demarcation point between the work of the Electrical Division and the Mechanical and Plumbing Divisions typically differ.

.2 Generally for drives, equipment, etc. detailed in the Mechanical Division, the work of the Electrical Division finishes with the supply of a standard terminal block array for each starter. All further wiring, relays, timers, etc., together with control consoles, are provided under the Mechanical Division.

.3 Generally for the package equipment, drives and special controls detailed in the Plumbing Division, the work of the Electrical Division typically includes the provision of all wiring, devices, etc., to complete each system and left ready for commissioning, set up, etc. by the Plumbing Division.

1.4 ELECTRICAL DIVISION RESPONSIBILITIES FOR MECHANICAL DIVISIONS

.1 Provide a ten point terminal block for each starter or contactor.

.2 Provide interwiring between starters or contacts and terminal blocks. Starter to be entirely factory-wired.

.3 Terminals to be as follows:

- .1 120 V line from control transformer.
- .2 Terminals for remote 3 wire stop/start.
- .3 HOA or other control.
- .4 120V neutral.
- .5 Normally open dry contact.
- .6 Common.
- .7 Normally closed dry contact.
- .8 Normally open dry contact.
- .9 Common.
- .10 Normally closed dry contact.

.4 Except where otherwise indicated, the work of the Electrical Division shall not extend beyond the control terminal blocks. The Mechanical Division shall provide all conduit, wire, wiring connections and components such as relays, timers, etc. as required to provide the interlocking functions and controls as outlined in the specifications. If the standard terminals supplied by the Electrical Division require supplementation in any way, e.g. by supplying additional N.O. or N.C. contacts, these facilities are included in the Mechanical Division scope.

.5 Mechanical Division shall provide the mechanical control consoles complete with pilot controls, indicating lights, etc., as outlined in the specifications.

.6 When an item provided under the Mechanical Division is factory supplied with a starter or contactor and it is necessary to alter or add to the control wiring in order to achieve the method of operation specified in the Mechanical Division, this work shall be included in Mechanical Division.

.7 When control items such as thermostats, float controllers, etc., are connected to power wiring in series with the item being powered (e.g. unit heater motor, fractional HP fans, etc.) the supply and installation of the controller devices are included in Mechanical Division. Power wiring to and from the controllers is included in the Electrical Division. Install line voltage thermostats for single phase motors provided by the Mechanical Division where specifically indicated on the drawings and/or the “Equipment Schedule” of this specification.

.8 When the electrical characteristics of a controlled item exceed the capacity of a specified controller, provision of a contactor and the required wiring shall be included in the Mechanical Division.

1.5 ELECTRICAL DIVISION RESPONSIBILITIES FOR PLUMBING DIVISIONS

.1 When a drive, motor, etc. provided under the Plumbing Divisions is factory supplied with a starter, contactor, alternator, pressure switch, etc., the wiring and installation of these items and controls shall be included in the Electrical Division.

.2 The ten point terminal blocks similar to those specified under the Mechanical Division controls are not mandatory for the Plumbing Division equipment.

.3 The Electrical Division shall provide stop/start or HOA controls as specified for each item except where these stations are factory supplied with equipment.

.4 The Electrical Division shall leave each system fully functional and requiring only minor final adjustments (such as pressure or vacuum settings) by the Plumbing Divisions.

Part 2 Products

2.1 MATERIALS

.1 Refer to appropriate section of the Electrical Division(s).

2.2 CONTROL RELAYS

.1 Control relays to be rated minimum 10 A, 300V, with contacts as required and 120 V control coil unless otherwise noted. Relays to be typically mounted in CEMA1 enclosures located in control terminal cabinets and/or MCC.

.2 Time delay relays to incorporate time delay feature to delay either opening or closing as specified. Time period to be adjustable from 0 to 5 minutes unless otherwise specified.

Part 3 Execution

3.1 INSTALLATION

.1 Provide all labour and materials required to complete power wiring for HVAC, Plumbing and Fire Protection equipment as called for in the project specifications and/or shown on the drawings.

.2 Provide all single and 3 phase motor protection switches, combination starters and disconnects contactors and relays as required for mechanical equipment unless otherwise specifically noted in these specifications or on the drawings.

.3 Terminate all line voltage wiring to the designated equipment terminals.

.4 Obtain a full set of HVAC control shop drawings and have a full understanding of the scope before commencing installation and including any fire alarm interface.

.5 Verify the recommended overcurrent protection and rating of Mechanical and Plumbing and Fire Protection equipment and equipment supplied by the Departmental Representative. Change feeder overcurrent protection as required to comply with equipment recommendations. Notify the Consultant of all revisions.

3.2 FIELD QUALITY CONTROL

.1 Cooperate with Mechanical Consultant and Contractor and check out the operation of all motor controls with all HVAC systems fully operational. Record all electrical loads. Replace any defective or wrongly sized starter overloads, heaters, fuses or circuit breakers.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00.

Part 2 Products

2.1 DISCONNECT EQUIPMENT

.1 "Heavy Duty" class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4.

.2 Fuseholder assemblies to CSA C22.2 No.39.

.3 Fusible and non-fusible disconnect switch in CSA enclosure.

.4 Provision for padlocking in off switch position.

.5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits.

.6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.

.7 Quick-make, quick-break action.

.8 ON-OFF switch position indication on switch enclosure cover.

.9 Weatherproof as required.

2.2 CONTACTOR EQUIPMENT

.1 Contactors: to CSA C22.2 No.14.

.2 Half size contactors not accepted.

.3 Electrically operated, electrically or mechanically held, multi-pole full voltage type.

.4 Contactors to have 120V operating (and unlatching) coils unless otherwise noted.

.5 Controlled by pilot devices as indicated and rated for type of load controlled.

.6 Breaker or fused switch combination contactor as indicated.

.7 Complete with 1 normally open and 1 normally closed auxiliary contacts unless indicated otherwise.

.8 Provide CEMA enclosure as required for location unless indicated otherwise.

2.3 CONTACTOR REMOTE CONTROLS

.1 Include following options in cover or in remote locations where indicated:

.1 Red LED indicating lamp (incandescent not acceptable).

.2 Stop-Start pushbutton.

.3 Hand-Off-Auto selector switch.

.2 Provide flush mounting boxes and satin stainless steel plates for remote control devices in finished areas. Provide industrial quality, malleable die cast surface mounted units to suit the application classification.

2.4 EQUIPMENT IDENTIFICATION

.1 Indicate name of load controlled on size 4 name plates to Section 26 05 00.

2.5 STANDARD OF ACCEPTANCE

.1 Cutler Hammer – Heavy Duty.

.2 Schneider - Heavy Duty.

.3 Siemens - Heavy Duty.

.4 Approved equivalent.

Part 3 Execution

3.1 DISCONNECT INSTALLATION

.1 Install disconnect switches complete with fuses where indicated or required.

.2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated or not on the contract drawings.

3.2 MOTOR PLUG/RECEPTACLE AND QUICK DISCONNECTS

.1 Motor quick disconnects do not negate the requirement for a switched safety disconnect as specified in this Division. A separate disconnect is still required unless the Consultant has given a special pre-approved circumstance.

3.3 CONTACTOR INSTALLATION

.1 Install contactors and connect auxiliary control devices.

.2 Pilot lights to be illuminated when contactor is closed.

.3 Control wire to be minimum #14 AWG. Remote control wiring to be 5A fuse protected and the wiring shall be upsized to limit voltage drop to no more than 2%.

.4 Control circuits shall be fail safe leaving the contactor in the open position if the power fails or where automatic reset could be a safety or operational concern. Provide a control circuit seal-in contact for all momentary contact control devices unless otherwise indicated.

.5 The contactor shall not automatically reset after a power failure unless otherwise indicated or for such items as automatic freeze protection, snow melting, light control, etc.

.6 Electrically held contactors to be located in service rooms where practical.

END OF SECTION